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Oak Ridge National Laboratory

Health Physics Division

ORNL
CENTRAL FILES NUMBER
54-2-186

APPLIED HEALTH PHYSICS QUARTERLY REPORT

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For Period September 28, 1953 - January 3, 1954

CLASSIFICATION CANCELLED
DATE 10/8/57
Edgar J. Murphy
CO-ORDINATING ORGANIZATION DIRECTOR
OAK RIDGE NATIONAL LABORATORY
AUTHORITY DELEGATED BY AEC 9-18-57

Submitted by J. C. Hart

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SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

Air activity for the last quarter continued along the same general levels as the previous quarter except for a four week period beginning November 2nd when the average was up by a factor of 5 to 10. This increase occurred during a continued chemical separations run in Bldg. 3026-D which may have been a contributing factor. The highest concentration occurred during the week ending November 22nd and was recorded on air monitor #5, just west of the tank farm, with a maximum reading of 1.2×10^{-10} µc/cc. The continued elevated air activity in the vicinity of #5 air monitor points to the tank farm and associated operations as a prominent source of air contamination. The weekly average long-lived activity for 1953 for all outside constant air monitors was 4.6×10^{-12} µc/cc which is 60.1% above the weekly average for 1952.

The average particulate activity for the year was 2.14 particles per 1000 ft^3 of air which is 36.1% less than the 1952 weekly average. Figure 1, a resume for the year, shows an increase in particulate activity during the period from November 2nd through November 29th with the highest average particle counts during the quarter occurring during the week ending November 29th. It is to be noted that the highest average particulate activity for the year for an individual air monitor was found on air monitor #5, which is again indicative of the fact that the tank farm may be a major source of airborne contamination.

Liquid waste discharges continued at a low level until the week ending November 22nd at which time a rise in waste discharges to the settling basin was noted. This increase continued for three weeks with a maximum weekly discharge of 31.37 curies during the week ending November 29th.

An increase in calculated concentration in the Clinch River lagged the settling basin increase in activity by approximately one week with a maximum calculated concentration of 6.32×10^{-7} µc/cc occurring for the week ending December 13th. During the week ending December 13th the average flow in the Clinch River at Mi. 20.7 was at its lowest point for the quarter, falling far below average with a flow of only 1545 cfs. Poor dilution as a result of this low flow was a significant factor in causing the high maximum reached. This particular rise in activity resulted from mechanical failure of lines and equipment in the tank farm discharging metal wastes and fission products directly to the settling basin. Had these accidental discharges not occurred, the yearly average calculated concentration in the Clinch River may have been below the MPC of 1×10^{-7} µc/cc for drinking water. As noted in Figure 2, the average concentration for the year was 1.13×10^{-7} µc/cc or about 1.7% below last year's weekly average. Although the amount of activity in the Clinch River during the year averaged only slightly above the allowable concentration for drinking water, it will be noted from Figure 3 that the MPC was exceeded 40.4% of the time.

AIR PARTICULATE ACTIVITY for 1953

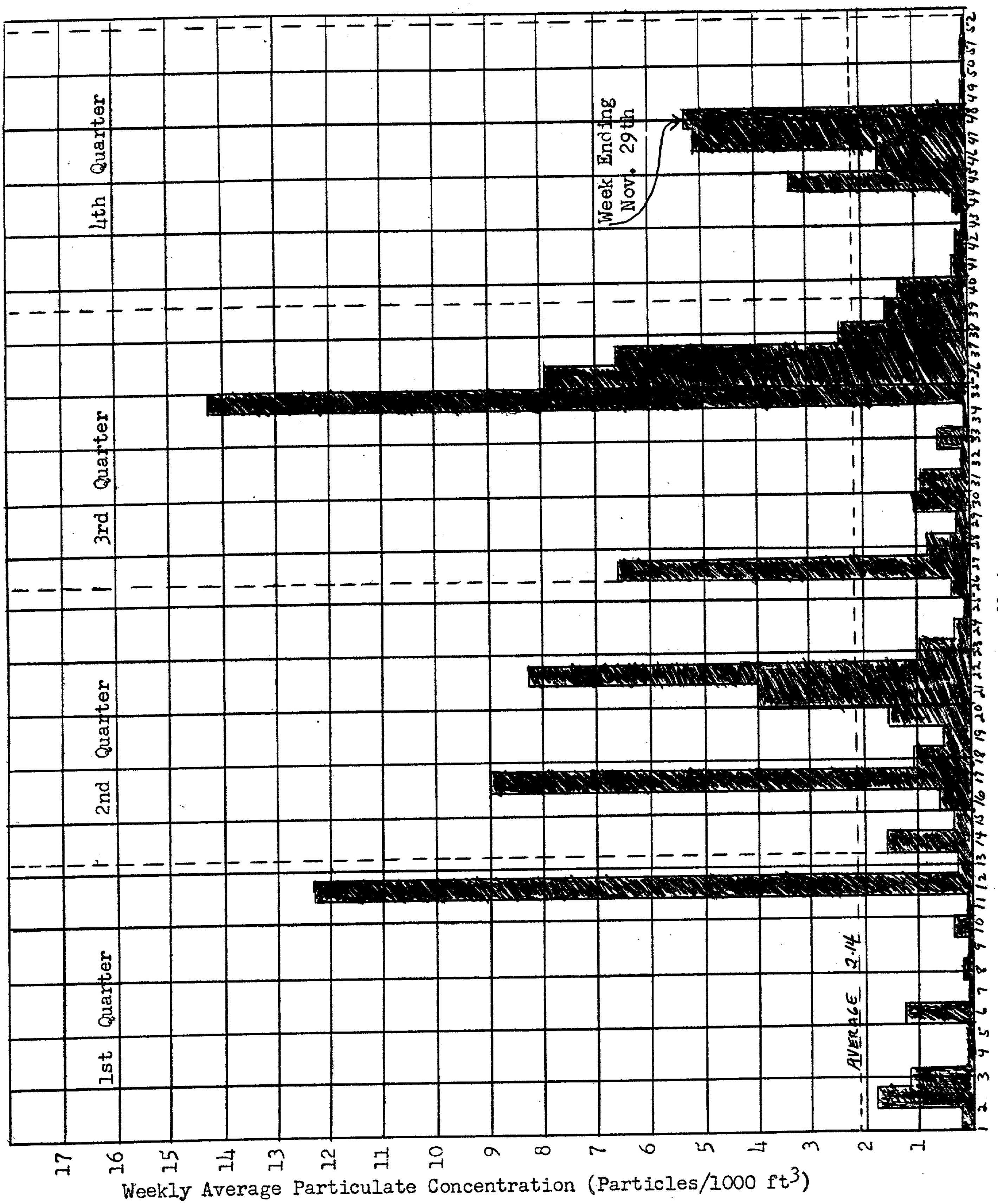

Figure 1

CALCULATED CONCENTRATION IN CLINCH RIVER BELOW WHITE OAK CREEK

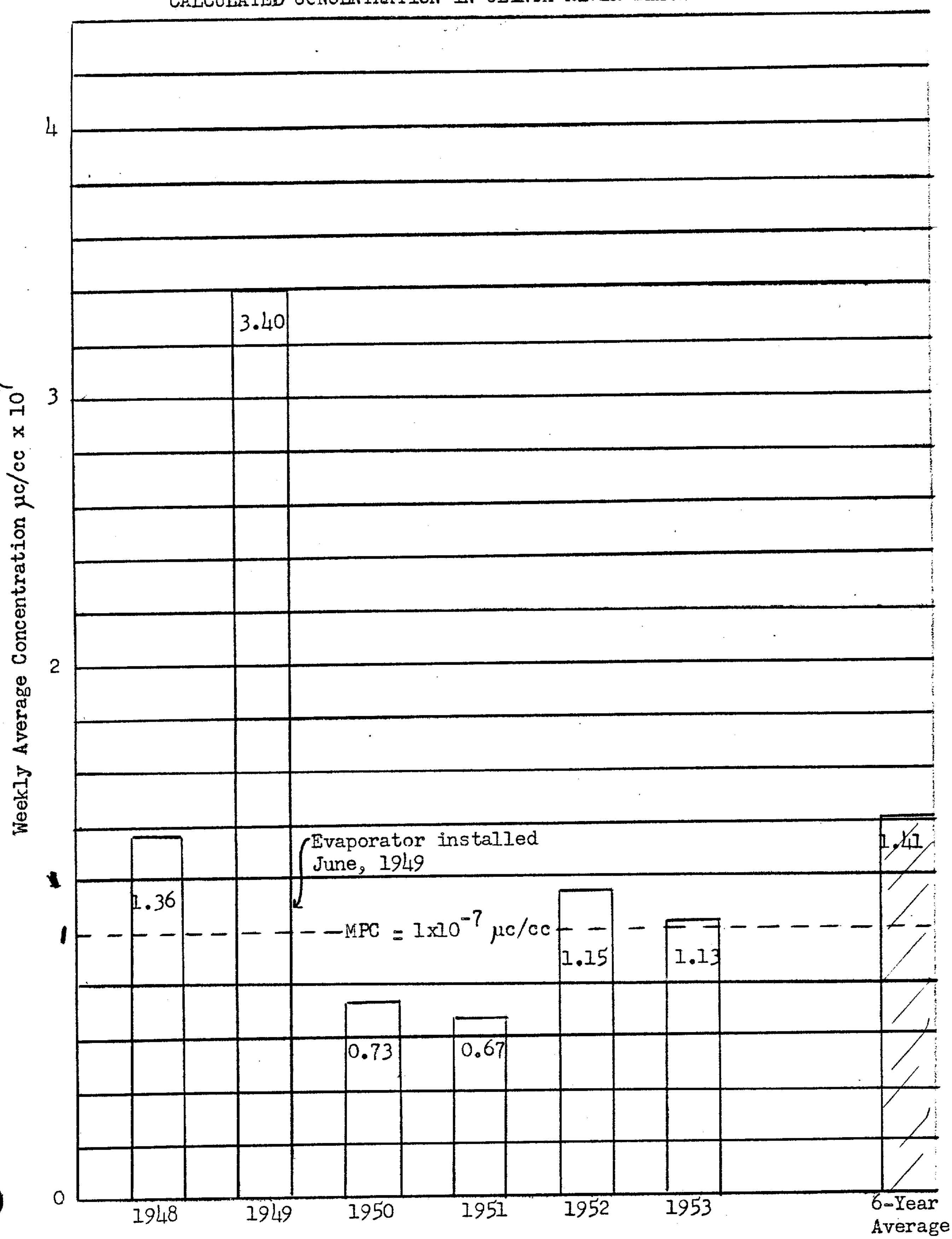

Figure 2

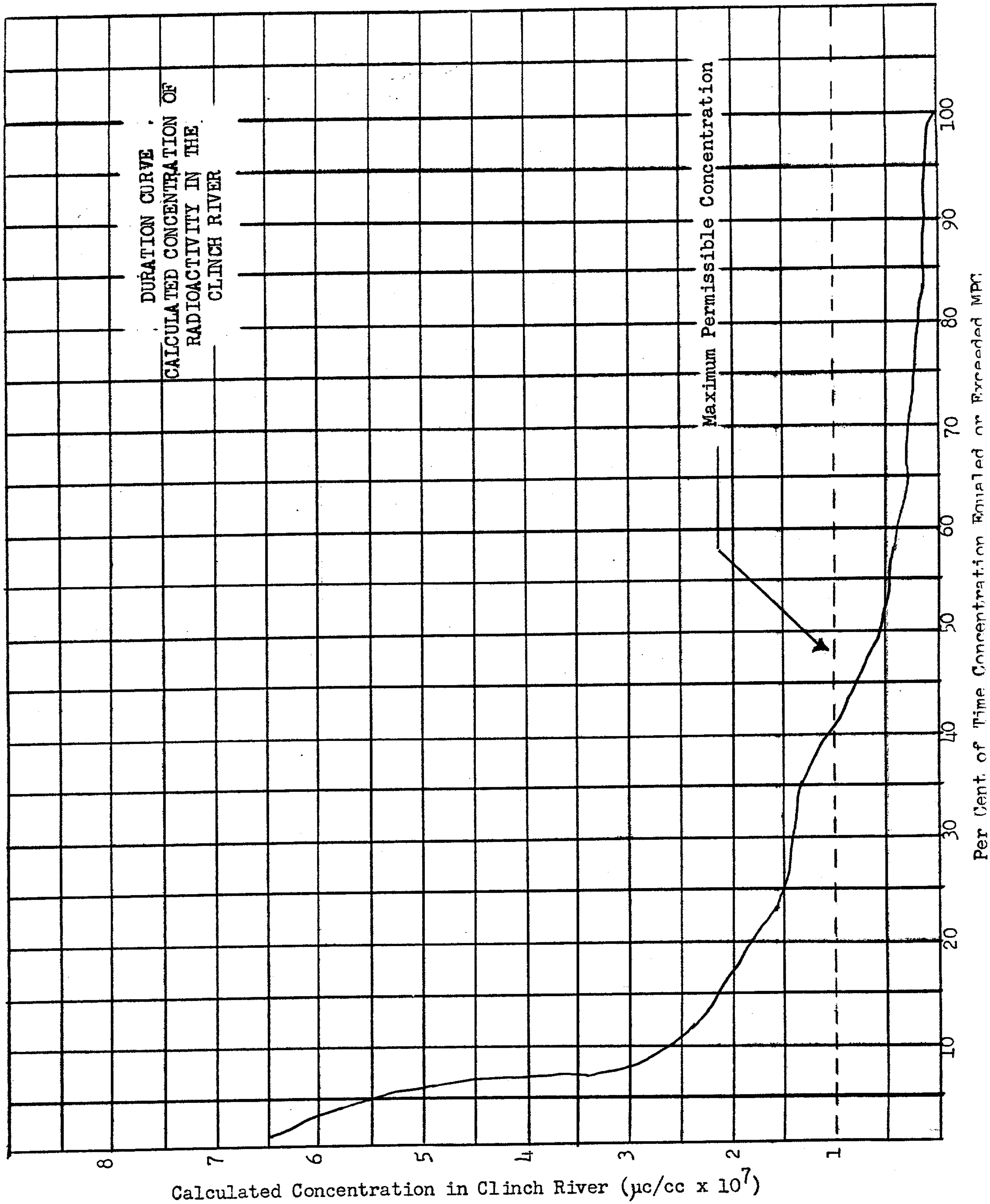
DURATION CURVE
CALCULATED CONCENTRATION OF
RADIOACTIVITY IN THE
CLINCH RIVER
Maximum Permissible Concentration
Per Cent of Time Concentration Equaled or Exceeded MPC
10
20
30
40
50
60
70
80
90
100
8
7
6
5
4
3
2
1
Calculated Concentration in Clinch River (µc/cc x 10^7)

Figure 3

It is to be noted that the weekly average number of curies discharged from White Oak Lake exceeded the weekly average discharged from the settling basin. During the first five months of 1953 a leak in the tank farm system bypassed the evaporator flowing through the retention pond directly into White Oak Creek. The total estimated activity discharged by this route was approximately 144 curies.

Laboratory work on samples taken in September for the annual mud survey of White Oak Lake was completed this quarter. Calculations from the data obtained indicated the radioactive content of the mud of White Oak Lake to be approximately 398 curies. A comparison with previous years is as follows:

1950	392 curies
1951	359 curies
1952	303 curies
1953	398 curies

Three trailers of equipment for logging some 54 core holes for radioactivity have been transferred from research to the Area Monitoring group. This is to determine to what extent, if any, the Laboratory is contributing to the contamination of the underground water of the area and study the transfer of this activity through the rock strata. Some preliminary logging has been done for familiarization with the equipment but no formal program of logging has yet been instituted. This should get under way some time during the coming quarter.

Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

Station Number	Location	Average Long Lived Activity: Wkly Av. for 1953, Conc. x 10^{-13} $\mu c/cc$	Deviation from 1952 Weekly Av.
HP-1	N 3550	34.70	+17.7%
HP-2	S 3001	27.70	-13.2%
HP-3	S 1000	22.53	+16.0%
HP-4	W 3513	11.98	+12.6%
HP-5	E 2506	290.27	+184.7%
HP-6	SE 3012	11.96	-37.7%
HP-7	W 7001	9.73	-9.7%
HP-8	Rock Quarry	11.75	-49.5%
HP-9	A-10 Site	11.33	-29.2%
HP-10	E 2074	32.02	+18.2%
Average all stations		46.40	+60.1%

2. Particulate Studies

a. USPHS Filters

Number	Location	Weekly Average for 1953	Deviation from 1952 Weekly Average
A-1	3026	3.67	-32.3%
A-2	3003	0.70	-66.0%
A-3	1000	0.70	-17.6%
A-4	7001	0.30	-25.0%
A-5	3550	7.52	+56.0%
Average all stations		2.58	-4.4%

b. CAM Filters

HP-1	N 3550	2.11	-69.4%
HP-2	S 3001	1.91	-65.8%
HP-3	S 1000	2.03	+8.0%
HP-4	W 3513	2.13	+156.6%
HP-5	E 2506	4.77	-36.2%
HP-6	SE 3012	1.63	-16.0%
HP-7	W 7001	1.45	+70.6%
HP-8	Rock Quarry	1.83	-41.7%
HP-9	A-10 Site	1.53	-31.1%
HP-10	E 2075	2.05	-23.2%
Average all CAMs		2.14	-36.1%

3. Meteorological Data

a. Rainfall

Total this year	43.88 inches
Normal yearly rainfall	52.04 inches
Deviation from normal seasonal rainfall	-2.1%

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin Beta	White Oak Lake Beta
Weekly Av. for 1953	5.58	5.84
Deviation from 1952 Weekly Average	-25.7%	+41.7%

b. Submersion Data

	Settling Basin			White Oak Lake		
	Beta mrep/hr	Gamma mr/hr	Total mr(ep)/hr	Beta mrep/hr	Gamma mr/hr	Total mr(ep)/hr
Weekly Av. for 1953	0.352	0.442	0.794	0.033	0.025	0.058
Deviation from 1952 weekly average	-24.0%	-50.5%	-41.4%	+26.9%	-43.2%	-17.1%

c. Plutonium Discharged

	Settling Basin		White Oak Lake	
	Conc. x 10^{-9} µg/cc	Total mg Plutonium	Conc. x 10^{-9} µg/cc	Total mg Plutonium
Weekly Av. for 1953	2469.3	38.562	134.7	26.106
Deviation from 1952 weekly average	-0.6%	-2.9%	+92.1%	+180.4%

d. Probable Average Concentration in Clinch River Below White Oak Creek*

Weekly average for 1953	1.13×10^{-7} µc/cc
Deviation from 1952 weekly average	-1.7%

*Calculated using as a dilution factor the ratio of White Oak Lake discharge to the flow of Clinch River

SECTION II. ASSAYS-INSTRUMENTS

Part A. Salient and Non-Routine Items

Approximately 200 chemical dosimeters were checked for the effects of light, heat, radiation, and shelf life. In general the results were as follows:

Light: There was no color change due to exposure of the meter to room light for several hours. There were marked changes in color in the positive direction when the meters were exposed for several minutes to sunlight or intense artificial light.

Heat: There was no color change due to exposures at body temperatures for 24 hours. Long exposures at body temperature or short exposures to high temperatures caused reversals or color changes in the negative direction.

Radiation: Color changes due to radiation were reproducible within 30% or less through the range from 0 to 16 r. Color changes will indicate, if proper care is exercised, within ± 2 r, doses from 4 r to 10 r. Depending upon the dose received, a time lapse of 15 minutes to 1 hour is required for complete change in color. The agitation of liquid increases the rate of color change. Within limits, the meter is independent of dose rate.

Shelf Life: Control instruments which were left in the stock room at normal room conditions varied from the equivalent of minus 4 r to plus 4 r.

Several of the dosimeters were exposed to relatively high doses of radiation (100 r to 500 r) and efforts made to determine the exposures by the titration method[1]. In general, the results indicated exposures from 10 to 50 per cent less than the calibrated dose. Other methods are being investigated.

The average number of samples processed per week in the counting room during 1953 showed a decrease of 13.8% over 1952. By coincidence, the number of samples processed by the Chemical Analysis group showed an increase of 13.8%. Since the technicians are interchanged between the two groups, these fluctuations do not produce any serious problems.

A scintillation type gamma counter was installed in the counting room, Bldg. 2001, for checking the chests of Laboratory personnel for insoluble gamma emitters. The sensitivity of this instrument is at least 15 times that of a GM Counter for most isotopes. There were approximately 200 checks made of chests and other portions of the body. Of those checked, which included most of the Applied Health Physics Sections, only two showed a consistent count above background.

[1] Titration method described in letter from Dr. George V. Taplin to J. C. Hart, dated September 28, 1953.

The samples processed by the Environs Unit are included in the Chemical Analysis report this quarter. This contributes to the increase in the number of samples processed by that unit.

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services This Quarter

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Per Week Alpha	Beta	Units/Count (unit = 2/3 min.)	Average Total Units Per Week for 1953
Smears		2289	2386	1	4675
Air Samples	170	217	250	3	1952
Ecological Survey		5	65	4	280
ERDL			50	4	200
Public Health			93	4	372
Area Monitoring			51	4	204
Decay and Absorption Curves	36		272	4	1232
Off-Area Monitoring			35	4	140
Gamma Chest Counts			14	4	56
Mud Samples			18	4	72

Average number of samples per week 9183

Deviation of the weekly average this quarter from weekly average of 1952 -23.5%

Total samples handled during 1953 537729

Deviation of 1953 weekly average from weekly average of 1952 -13.8%

b. Chemical Analysis

	Av. No. per Wk.
Pu	23.5
U	16.5
Sr, Y, Pb, Gross α and β	5.5
FP	18.3
Off-Area Rain Water and Fall Out	32.0

Average number of samples per week 95.8

Deviation of the weekly average this quarter from weekly average of 1952 +36.9%

Total samples handled during 1953	4143
Deviation of 1953 weekly average from weekly average of 1952	+13.8%

2. Calibration Unit

a. Film Routine

Average number of films calibrated per week	302
Deviation of the weekly average this quarter from the weekly average of 1952	-57%
Total films calibrated during 1953	28390
Deviation of 1953 weekly average from weekly average of 1952	-36%

b. Instrument Routine

Average number of instruments calibrated per week	113
Deviation of the weekly average this quarter from the weekly average of 1952	-6%
Total instruments calibrated during 1953	6415
Deviation of 1953 weekly average from weekly average of 1952	+1%

3. Source Inventory

		On Hand
a.	Radium	14
b.	Po-Be	1
c.	Cesium	1
d.	Uranium discs	68

4. Portable Instruments Repaired

a.	Average number of instruments repaired per week	41
b.	Deviation of the weekly average this quarter from weekly average of 1952	-2%
c.	Total instruments repaired during 1953	2189
d.	Deviation of 1953 weekly average to date this year from weekly average of 1952	-1%

5. Operation of Fixed and Semi-Portable Instruments*

		1	2	3	4	5	6
a.	Constant Air Monitors	3536	1977	1559	117	43	3
b.	Monitrons	3536	2203	1333	118	38	3
c.	Hand and Foot Ctrs.	785	303	482	30	61	4
d.	A.C.Poppies (Alpha & Beta-Gamma)	1224	393	831	16	68	1
e.	Scalers (including alpha counters)	1736	818	918	50	53	3
f.	Precipitrons	340	129	211	0	62	0
g.	Friskers	408	194	214	47	52	11
h.	Filtrons	408	0	408	0	100	0

*Explanation for Column Headings:

1. Total number of "Instrument Days" where an "instrument day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operation reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Per cent of "Instrument Days" not reported.
6. Per cent of "Instrument Days" instrument reported out of service.

6. Instrument Adjustment Unit

a. Projects Completed During This Quarter

(1) For Applied Health Physics Section

Rehabilitated and adjusted instruments for display cabinet.
Designed and built unit for monitoring fire alarms and other emergencies.

(2) For Research Section

Modified three amplifiers and made revisions on two additional units.
Modified an R.F. Oscillator and made revisions on other instruments of this type.
Modified and adjusted instruments used by the U.S. Geological Survey group.

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

With the completion of the personnel monitoring exposure records for 1953, an experience of a little over three months with the new plastic film meter was noted. As was to be expected, a few details were overlooked relative to the distribution and collection of the meters. Most of the problems were worked out to the satisfaction of the personnel monitoring program. The Security Department collected figures relative to the number of lost badges with the result that the badge film meter was being lost at a rate of five to one over the old type identification pass. There is no apparent reason for this increase other than human error.

In general, the number of weekly exposures in excess of 300 mrep as based on the PTR decreased over the previous year of 1952. Figure 4 is a breakdown by divisions giving this comparison. In passing, it should be noted that no employee exceeded the maximum permissible exposure for the year.

Number of Weekly Exposures > 300 mrep, Based on PTR, for the Year 1953
(1952 figures given for comparative purposes)

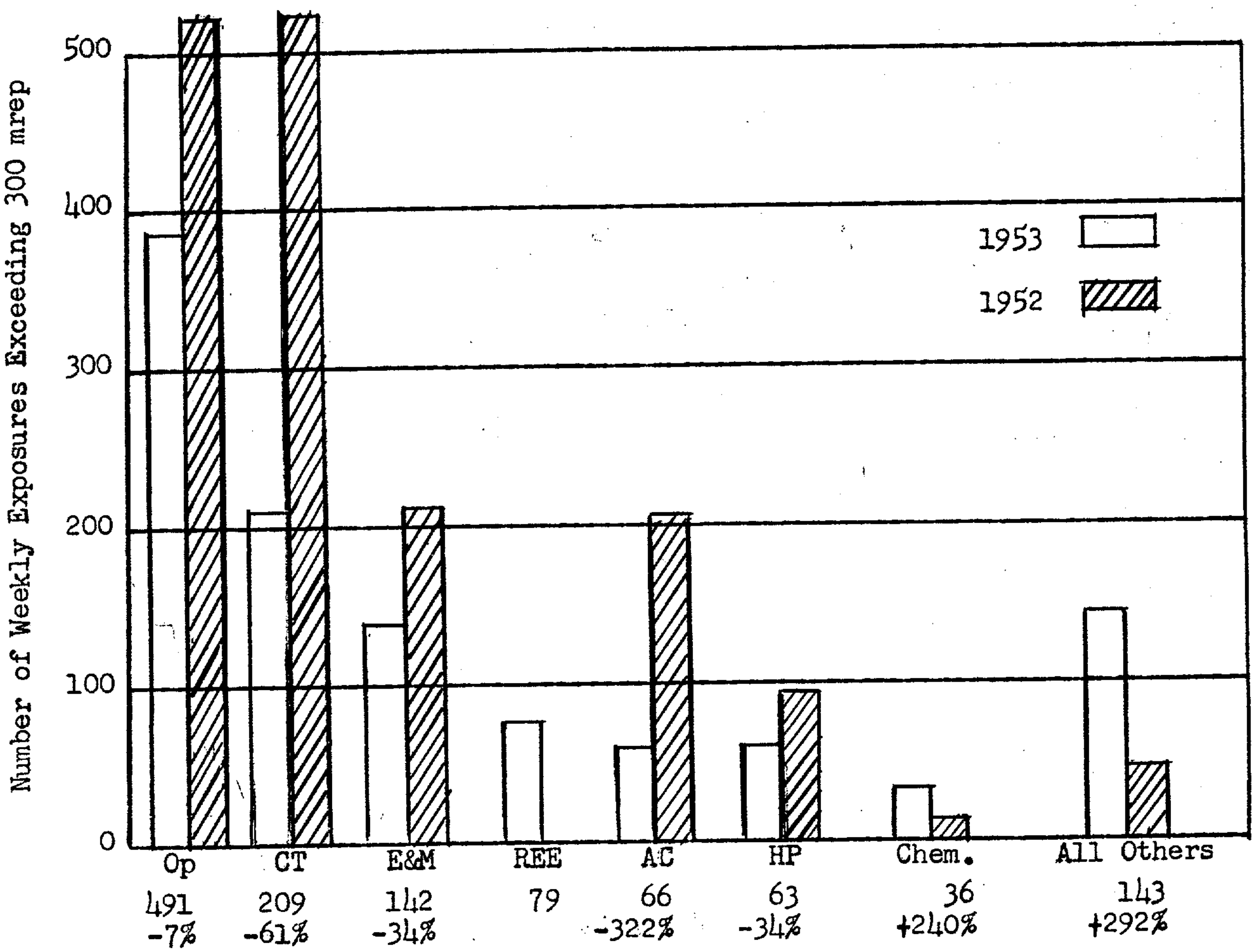

Figure 4

Part B. Statistical Data

1. Personnel Meters

a. Distribution and Performance of Pocket Meters

	Weekly Av. for 1953	Deviation of 1953 Weekly Av. from 1952 Weekly Average
Meters distributed	11853	-32.3%
Readable meters	11843	-32.3%
Non-readable meters	10	+48.1%
Non-readable pairs	0.02	-86.7%
Off-scale readings	41	-47.4%
Off-scale pairs	2.38	-40.2%

b. Distribution and Processing Data of Film Meters

West Portal	1981	-22.9%
East Portal	914	+41.5%
Visitors	352	+54.4%
Ring films, packets, etc.	133	+13.7%
Routine neutron films	220	+10.6%
Special neutron films	20	-23.1%
Calibrations	205	-38.6%
Correspondents	2096	+7.7%
Special X-ray films	30	-9.1%
Total films handled	5951	-2.4%

c. Film Meter Data Loss

Badge meters not serviced	25.19	+124.7%
Films lost	0.02	-80.0%
Films damaged	0.19	+375.0%
Total	25.40	+123.8%

2. Investigations Initiated

a. From Pocket Meter Records

Significant total of 300 mr(ep) or more	1.19	-72.7%
Off-scale pairs	2.40	-39.7%
Non-readable pairs	0.02	-86.7%
Total	3.61	-57.5%

	Weekly Av. for 1953	Deviation of 1953 Weekly Av. from 1952 Weekly Average
b. From Film Meter Records		
Weekly PTR of 300 mr(ep) or more	19.51	-32.4%
Questionable PTR of 300 mr(ep) or more	1.19	+98.3%
Lost or damaged films	0.21	+61.5%
Total	20.91	-29.3%
c. Paired off-scale pocket meters investigated to date this year		127
Legitimate number of off-scale pocket meter pairs to date		76
Statistical probability of spurious (paired off-scale) pocket meter readings to date this year		3.63
3. Laundry Decontamination Measurements		
Garments	3808	-7.8%
Prs. of shoes for replacement	18	-68.4%
Special items	944	-47.4%
Total	4770	-20.3%

SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

Reactors, Accelerators, and Related Physics Surveys:

Six incident reports involving accidents or near accidents with radioactive materials were issued during the quarter.

Three of the incidents involved the release of radioactive gases from a Xenon-Krypton apparatus located on the east side of the 7500 Bldg. The incidents necessitated the evacuation of the building for short periods of time. No serious personnel or contamination hazards evolved. These three incidents were covered in reports RS-126-53, 135-53, and 137-53.

One incident involved the contamination of approximately 4 sq.ft. of floor space in the Chemistry Laboratory, 7500 Bldg. The material spilled was approximately 250 λ solution from the HRE system. Decontamination procedures were effective in reducing the readings to acceptable levels. This incident is described in RS-133-53.

On November 25, 1953, jacket failures on W-slugs necessitated their removal from the LITR to the canal in Bldg. 3001. In the process of transferring the slugs to the canal, sections of roadway between the two buildings became contaminated. Removal of small sections of the road surface was necessary in effecting decontamination. This incident is described in RS-134-53.

On October 16, 1953, a section of Bldg. 3025 became contaminated when enriched uranium and stainless steel particles were tracked from Cell I to other parts of the building. This incident is described in RS-129-53.

General Research, Chemistry, and Operations Surveys:

During this period three unusual incidents involving accidents or near accidents with radioactive materials were reported as follows:

On November 10, 1953, a solution containing mixed fission products from the "crud" filter was spilled on the floor at the southwest corner of Cell A in Bldg. 3026-D. Versene, citric acid, soap and water were used in removing the contamination. This incident is described in RS-132-53.

A sample containing radioactive material was dropped from A-1 blister in Bldg. 3026-D on November 6, 1953. The immediate area around the sampler was decontaminated using versene, citric acid, soap and water. This incident is described in RS-131-53.

Three trailers loaded with drums of depleted uranium from Harshaw Chemical Company in Cleveland, Ohio were delivered to Bldg. 3505 on November 10, 1953. A survey revealed that the bed, frames, and sides of the trailer beds were contaminated. The incident was covered in a report dated November 17, 1953, subject: "Shipment of Depleted Uranium from Harshaw Chemical Company, Cleveland, Ohio."

Data Compiled by: A. D. Warden, et al
D. M. Davis
J. C. Ledbetter
H. H. Abee

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Oak Ridge National Laboratory Health Physics Division

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CENTRAL FILES NUMBER
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APPLIED HEALTH PHYSICS QUARTERLY REPORT

For Period January 4, 1954 - April 4, 1954

CLASSIFICATION CANCELLED
DATE 10/16/57
Edgar J. Murphy
CO-ORDINATING ORGANIZATION DIRECTOR
OAK RIDGE NATIONAL LABORATORY
AUTHORITY DELEGATED BY AEC 9-18-57

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24. ORNL-RC
25-50. File

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This document has been approved for release to the public by:

David R Hamrin 5/21/96
Technical Information Officer Date
ORNL Site

SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

In general, air activity for the quarter showed a decrease over the last quarter. The highest average activity for the Laboratory Area occurred during the week ending January 25th, with a reading of 1.08×10^{-11} μc/cc. The maximum concentration recorded for a single air monitor was 4.33×10^{-11} and was found on Constant Air Monitor #1 situated just north of Bldg. 3550. The average reading for the quarter for all outside Constant Air Monitors was 3.4×10^{-12} μc/cc which is 39.4% below the average for the last quarter and 26% below the average for 1953.

Particulate activity continued without appreciable change. The average particle count for the quarter for all air monitors was 1.44 particles per 1000 ft^3 of air sampled. Fig. 1 shows this to be a 4.3% increase over that experienced during last quarter but 32.7% below the average particle count for 1953. The highest average particle count occurred during the week ending February 22nd with a count of 7.39 particles per 1000 ft^3. This apparently resulted from a single surge of activity with a low particle count preceding and following the high count. The source of this activity has not been determined.

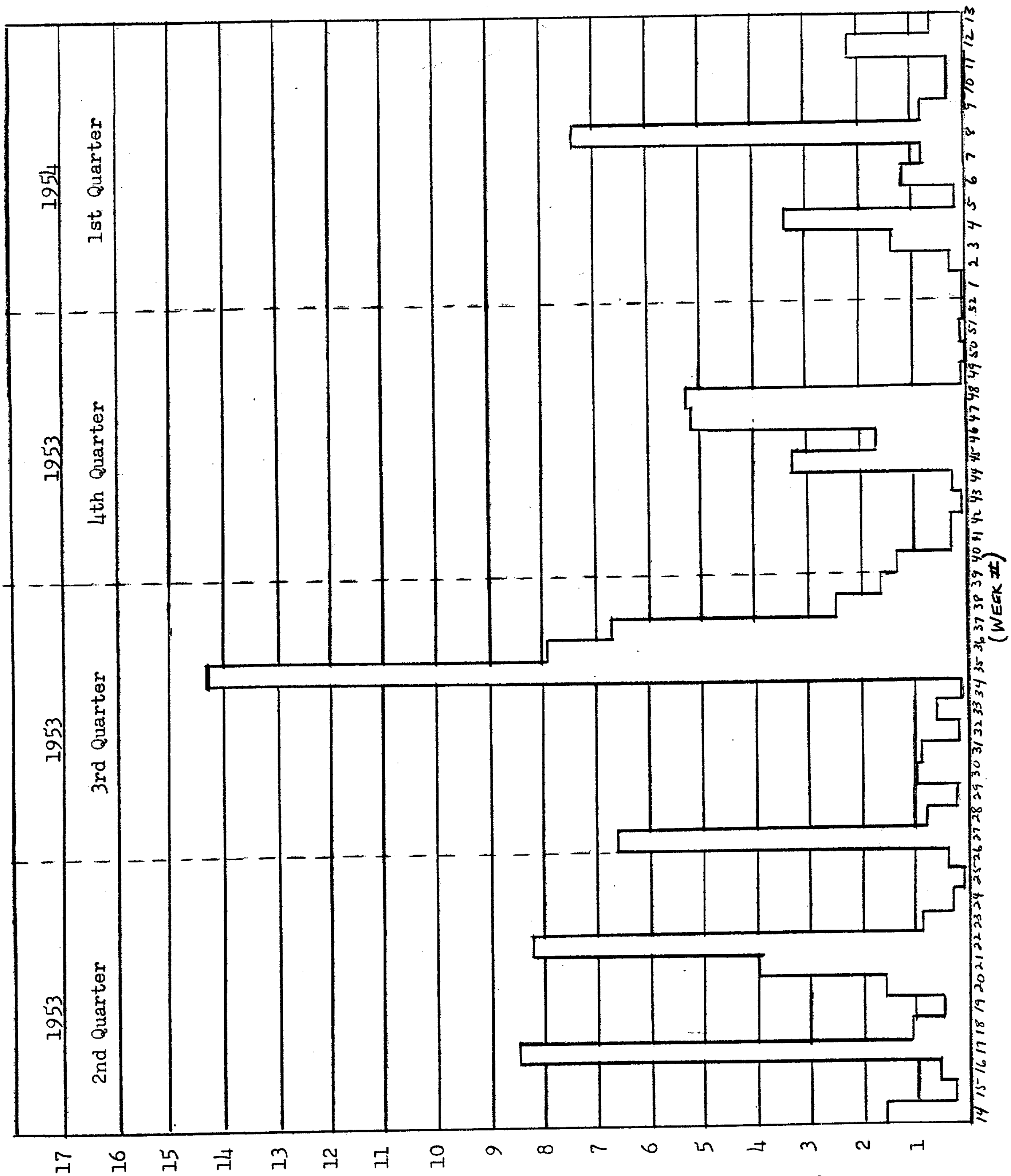
Radioactive material leaving White Oak Lake was up by a factor of approximately 2.5 over the amount released last quarter. It is of interest to note that activity releases from the Lake exceeded those from the Settling Basin. This may be explained, in part, by releases from the LITR, Retention Pond, and HRE which went directly into White Oak Creek tributaries by-passing the Settling Basin.

The calculated weekly average concentration of radioactive material in the Clinch River has been elevated for the entire quarter exceeding the MPC of 10^{-7} μc/cc for drinking water, Fig. 2, over 75% of the time. The maximum calculated concentration occurred during the week ending March 27th, with a value of 4.22×10^{-7} μc/cc. The average weekly calculated concentration to date this year is 1.95×10^{-7} μc/cc which is 101% above that for the last quarter and 72.6% over the average for 1953.

Background activity on the Laboratory Site, taken monthly at some 52 stations, showed an increase of 73.8% over last quarter and 111.5% above the average for 1953. This increase may be attributed to the chemical separations run in 3026-D during the month of January. Background activity which was measured for January during this time showed a large increase over previous and following months, resulting in a high average activity for the quarter.

With the advent of the new clothing policy during January, the responsibility for checking khaki garments, prior to sending them to commercial laundries, was transferred from the Personnel Monitoring Section to the Area Monitoring Section. All garments were checked for beta, gamma, and alpha activity. In all, a total of 24018 garments were handled. Of

AIR PARTICULATE ACTIVITY



Weekly Average Particulate Concentration (Particles/1000 ft^3)

Figure 1

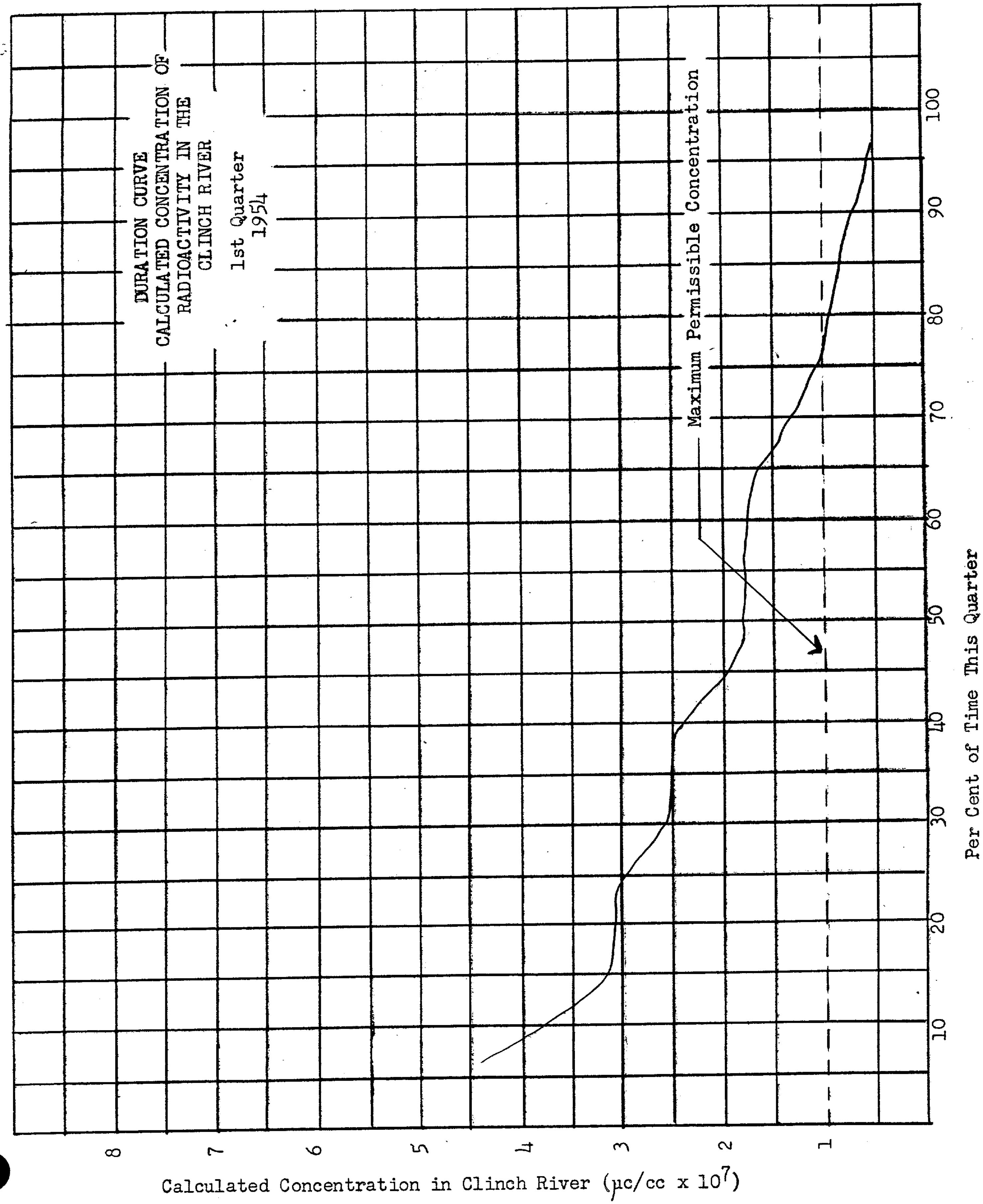

DURATION CURVE
CALCULATED CONCENTRATION OF RADIOACTIVITY IN THE CLINCH RIVER
1st Quarter 1954
Maximum Permissible Concentration
Per Cent of Time This Quarter
10
20
30
40
50
60
70
80
90
100
8
7
6
5
4
3
2
1
Calculated Concentration in Clinch River (μc/cc x 10^7)

Figure 2

this total, 12,335 garments were rechecked after being washed at a commercial laundry and used again in the field. A total of 4.7% of the rechecked garments were found to be above the maximum permissible limits for clothing following re-use in the field.

Installation of an electric fish barrier in the culvert under White Wing road at White Oak Dam was completed this quarter. The barrier, which was installed to prevent the migration of fish to and from White Oak Lake, has been demonstrated to be effective for this purpose.

Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

Station Number	Location	Average Long Lived Activity: Wkly Av. to Date, Conc. x 10^{-13} μc/cc	Dev. from Last Year
HP-1	N 3550	76.63	+103.3%
HP-2	S 3001	79.53	+187.1%
HP-3	S 1000	12.74	-43.5%
HP-4	W 3513	5.80	-51.6%
HP-5	E 2506	101.18	-65.1%
HP-6	SE 3012	20.27	+69.5%
HP-7	W 7001	5.29	-45.6%
HP-8	Rock Quarry	1.91	-83.7%
HP-9	A-10 Site	6.20	-45.3%
HP-10	E 2074	33.75	+5.4%
Average		34.33	

Deviation of this year's average long lived activity to date from last year's average -26.0%

2. Particulate Studies

a. USPHS Filter

Number	Location	Weekly Average to Date This Yr. Particles/1000 ft^3	Deviation of Wkly Av. to Date This Year from Wkly Av. Last Year
A-1	3026	1.94	-47.1%
A-2	3003	0.10	-85.7%
A-3	1000	0.31	-55.7%
A-4	7001	0.05	-83.3%
Average		0.60	

Deviation of this year's weekly average to date from weekly average last year -55.2%

b. CAM Filters

Number	Location	Weekly Average to Date This Yr. Particles/1000 ft^3	Deviation of Wkly Av. to Date This Year from Wkly Av. Last Year
HP-1	N 3550	2.19	+3.8%
HP-2	S 3001	0.75	-60.7%
HP-3	S 1000	0.52	-74.4%
HP-4	W 3513	0.37	-82.6%
HP-5	E 2506	7.52	+57.7%
HP-6	SE 3012	1.15	-29.4%
HP-7	W 7001	0.24	-83.4%
HP-8	Rock Quarry	0.20	-89.1%
HP-9	A-10 Site	0.32	-79.1%
HP-10	E 2074	1.17	-42.9%
Average		1.44	

Deviation of this year's weekly average to date from weekly average last year -32.7%

3. Meteorological Data

a. Rainfall

Total this year	20.45 inches
Normally yearly rainfall	52.04 inches
Deviation from normal seasonal rainfall	+50.6%

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin	White Oak Lake
	Beta	Beta
Weekly Av. for 1954	3.74	10.26
Deviation from 1953 weekly average	-30.5%	+75.7%

b. Submersion Data

	Settling Basin			White Oak Lake		
	Beta mrep/hr	Gamma mr/hr	Total mr(ep)/hr	Beta mrep/hr	Gamma mr/hr	Total mr(ep)/hr
Weekly Av. for 1954	0.305	0.242	0.547	0.018	0.014	0.033
Deviation from 1953 weekly average	-13.4%	-45.3%	-31.1%	-45.5%	-44.0%	-43.1%

c. Plutonium Discharged

	Settling Basin		White Oak Lake	
	Conc. x 10^{-9} µg/cc	Total mg Plutonium	Conc. x 10^{-9} µg/cc	Total mg Plutonium
Weekly Av. for 1954	847.6	10.896	29.5	46.961
Deviation from 1953 weekly average	-65.7%	-71.7%	-78.1%	-79.9%

d. Probable Average Concentration in Clinch River Below White Oak Creek*

Weekly average for 1954	1.95 x 10^{-7} µc/cc
Deviation from 1953 weekly average	+72.6%

*Calculated using as a dilution factor the ratio of White Oak Lake discharge to the flow of Clinch River

SECTION II. ASSAYS-INSTRUMENTS

Part A. Salient and Non-Routine Items

A scintillation counter has been installed in the counting room for checking the chests and thyroid of employees exposed to airborne activity. Preliminary tests and calibrations have been completed and the instrument is now available for routine analysis.

Two additional "off-area" sampling stations were installed this quarter. One is located at Berea College in Kentucky and the other at the University of Tennessee.

The counting room staff was reduced by 25% during this quarter with the result that the number of samples accepted for processing was reduced. The average number of samples processed for this quarter was 17% below the average for 1953.

Bureau of Standards data indicates that the Eastman 5302 film may be adaptable as a high range disaster film. A limited quantity of this type film has been given preliminary tests. The complete testing program should be completed before July 1, 1954 at which time results will be published.

Preliminary tests by the Radiation Dose Section of the Health Physics Division indicate that the duPont 555 film has a more useful range than either the 502 or 510 film. These tests were verified by additional exposures by the Calibrations Unit. In the most used range (0 to 300 mr) the 555 emulsion is blackened by a factor of approximately 3 to 1 over the 502 emulsion. It is indicated that the film has a useful range up to 300 r using the present processing techniques.

A simplified Hand and Foot Counter has been completed and is undergoing field tests. The basic instrument for this counter is a squid which was used with only a moderate amount of alteration.

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services This Quarter

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Per Week Alpha	Beta	Units/Count (unit = 2/3 min.)	Average Total Units Per Week for 1954
Smears		2080	2066	1	4146
Air Samples	144	197	188	3	1587
Waste Disposal			75	4	300
ERDL			14	4	56
Public Health			144	4	576
Area Monitoring			27	4	108
Decay and Absorption Curves	227			2	454
			324	4	1296
Off-Area Monitoring			15	4	60

Average number of units per week	8583
Deviation of the weekly average this quarter from weekly average of 1953	-17%
Total units handled to date this year	111566
Deviation of weekly average to date this year from weekly average of 1953	-17%

b. Chemical Analysis

	Av. No. per Wk.
Pu	12.6
U	11.0
Sr, Y, Pb, Gross α and β	9.9
FP	17.4
Off-Area Rain Water and Fall Out	29.5
Pu from Settling Basin and Lake	3.7
Monthly Composites	2.3
Average number of samples per week	86.4
Deviation of the weekly average this quarter from weekly average of 1953	+8.4%
Total samples handled to date this year	1123
Deviation of weekly average to date this year from weekly average of 1953	+8.4%

2. Calibration Unit

a. Film Routine

Average number of films calibrated per week	360
Deviation of the weekly average this quarter from the weekly average of 1953	-34%
Total films calibrated	4680
Deviation of 1954 weekly average from weekly average of 1953	-34%

b. Instrument Routine

Average number of instruments calibrated per week	117
Deviation of the weekly average this quarter from the weekly average of 1953	-3%
Total instruments calibrated	1526
Deviation of 1954 weekly average from weekly average of 1953	-3%

3. Source Inventory

	On Hand
a. Radium	14
b. Po-Be	1
c. Cesium	1
d. Uranium discs	68

4. Portable Instruments Repaired

a. Average number of instruments repaired per week	47
b. Deviation of the weekly average this quarter from weekly average of 1953	+15%
c. Total instruments repaired during 1954	611
d. Deviation of 1954 weekly average to date this year from weekly average of 1953	+15%

5. Operation of Fixed and Semi-Portable Instruments*

		1	2	3	4	5	6
a.	Constant Air Monitors	3500	1143	2357	59	67%	1.7%
b.	Monitrons	3520	723	2797	25	79%	0.7%
c.	Hand and Foot Ctrs.	710	149	561	18	79%	2.5%
d.	A.C.Poppies (Alpha & Beta-Gamma)	1150	268	882	4	77%	0.3%
e.	Scalers (including alpha counters)	1815	670	1145	60	63%	3.3%
f.	Precipitrons	325	51	274	0	84%	0.0%
g.	Friskers	410	112	298	32	73%	7.8%
h.	Filtrons	370	0	370	0	100%	0.0%

*Explanation for Column Headings:

1. Total number of "Instrument Days" where an "Instrument Day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operational reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Per cent of "Instrument Days" not reported.
6. Per cent of "Instrument Days" instrument reported out of service.

6. Instrument Adjustment Unit

a. Projects completed during this quarter

Construction of hand and foot counter.
Constructed two oscillators.
Constructed Q pulser.
Constructed HV adjustment boxes.
Repaired traffic counter.
Repaired oscillograph.

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

A revision in the Personnel Monitoring reporting system has been introduced to reflect an MPE of 0.5 rep/wk/13 wks when 0.2 rep or more, of the radiation consists of "soft" components. Soft components of radiation are considered to be radiation which will not penetrate an average depth of 5 centimeters in soft tissue.

All Laboratory employees are now being monitored with NTA films for neutron exposure. A spot check of films worn by employees whose badges previously were not serviced with the NTA film gave no indication of neutron exposures.

De-emphasis in the use of pocket meters by employees who are not normally exposed to radiation above normal background levels resulted in a reduction by 40% of meters used per week this quarter as compared to the weekly average of 1953.

A reduction of 29% of films processed per week this quarter compared to the weekly average of 1953 was effected by the discontinuance of off-area film monitoring service.

Investigations reveal that there were nine cases where monitoring films, being worn off plant, were exposed to therapeutic X rays.

A 20% reduction in the monitoring staff was effected this period.

One Personnel Monitoring Supervisor was transferred to the Radiation Survey Section. One member of the Radiation Survey Section completed three months of training in Personnel Monitoring.

A model of a monitoring film coding machine was completed and tested. A work order for two modified production units has been issued.

During the period, personnel exposures continued at normal rates. Fig. 3 is a breakdown by Laboratory Divisions showing the number of significant exposures where a significant exposure is defined as being equal to or greater than one-half of the weekly MPE. In addition to the number of significant exposures, Fig. 3 reflects the number of cases where the weekly MPE and the quarterly MPE is exceeded. In general, the greatest number of exposures, as determined by this method, were sustained by the Operations and E&M Divisions. The number of exposures sustained by the E&M Division for the period resulted from numerous rebuilding programs now underway.

Fig. 4 is a breakdown by Laboratory Divisions showing the number of overage weeks and the number of persons involved. An "overage week" is a term used to reflect the amount of time that an individual must abstain from exposure to radiation in order that his average exposure will not exceed

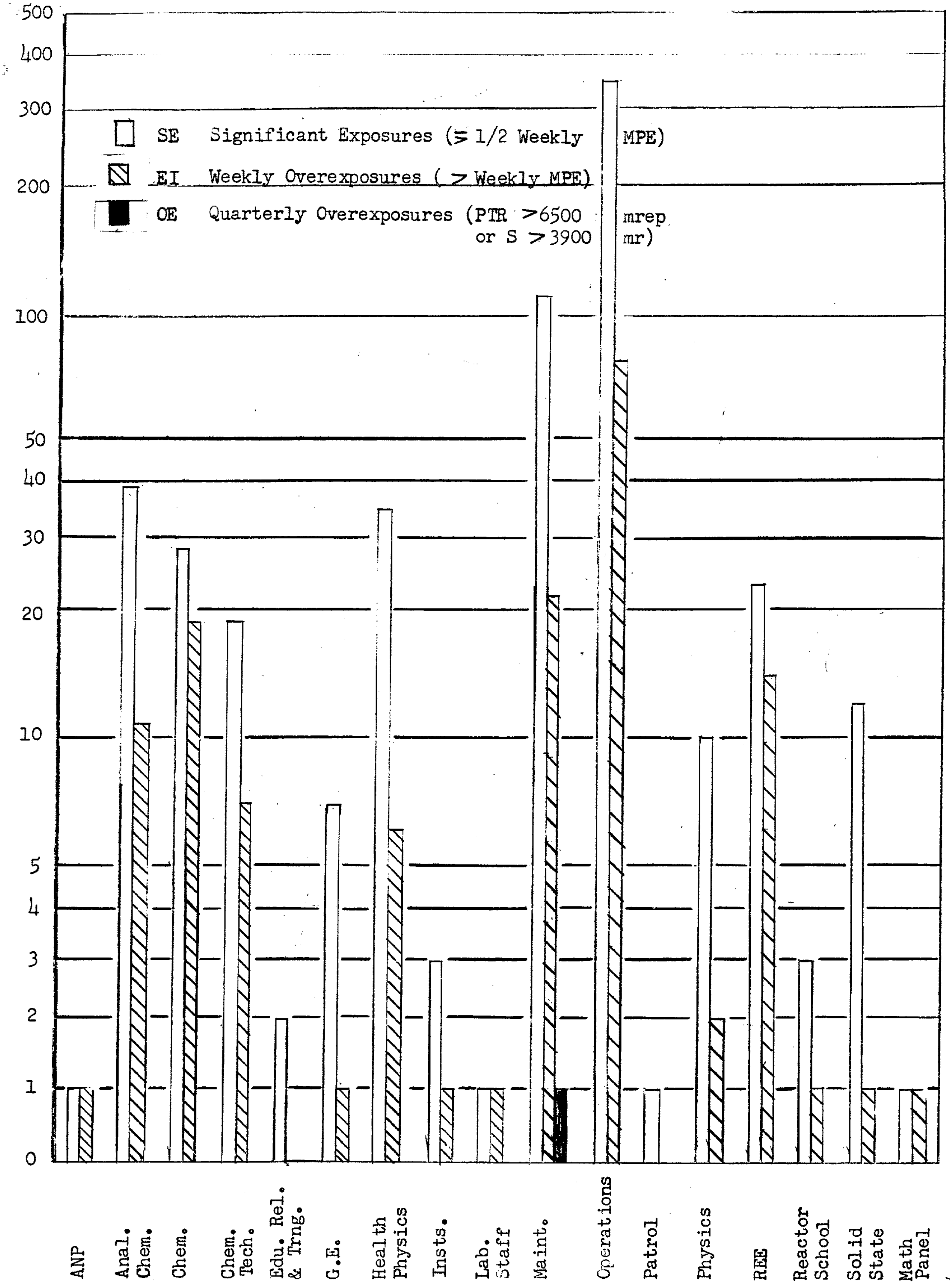
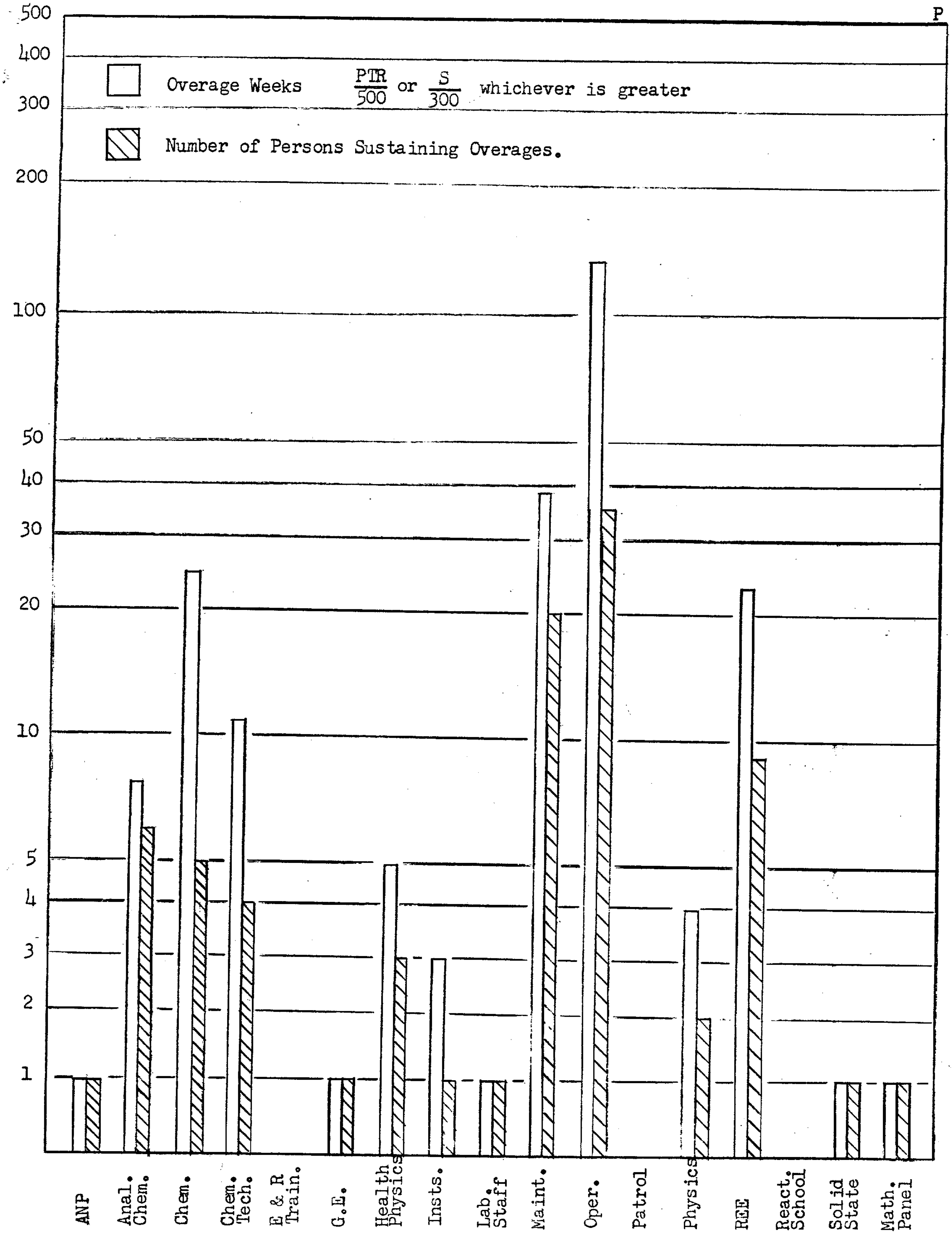

500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
0
SE Significant Exposures (≥ 1/2 Weekly MPE)
EI Weekly Overexposures (> Weekly MPE)
OE Quarterly Overexposures (PTR >6500 mrep
or S >3900 mr)
ANP
Anal. Chem.
Chem.
Chem. Tech.
Edu. Rel. & Trng.
G.E.
Health Physics
Insts.
Lab. Staff
Maint.
Operations
Patrol
Physics
REE
Reactor School
Solid State
Math Panel

Figure 3



500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
Overage Weeks $\frac{PTR}{500}$ or $\frac{S}{300}$ whichever is greater
Number of Persons Sustaining Overages.
ANP
Anal. Chem.
Chem.
Chem. Tech.
E & R Train.
G.E.
Health Physics
Insts.
Lab. Staff
Maint.
Oper.
Patrol
Physics
REE
React. School
Solid State
Math. Panel

Figure 4

the established MPE. Fig. 4 is significant in that it reflects the extent to which a Division, as such, must plan the work assignments for those individuals who sustain radiation exposures.

Figures 3 and 4 reflect exposure trends within groups and more or less deal with average conditions. Of greater interest is the individual employee and his experience with radiation exposure. Fig. 5 is a plot showing the exposure total of the ten employees who sustained the highest exposures during the quarter.

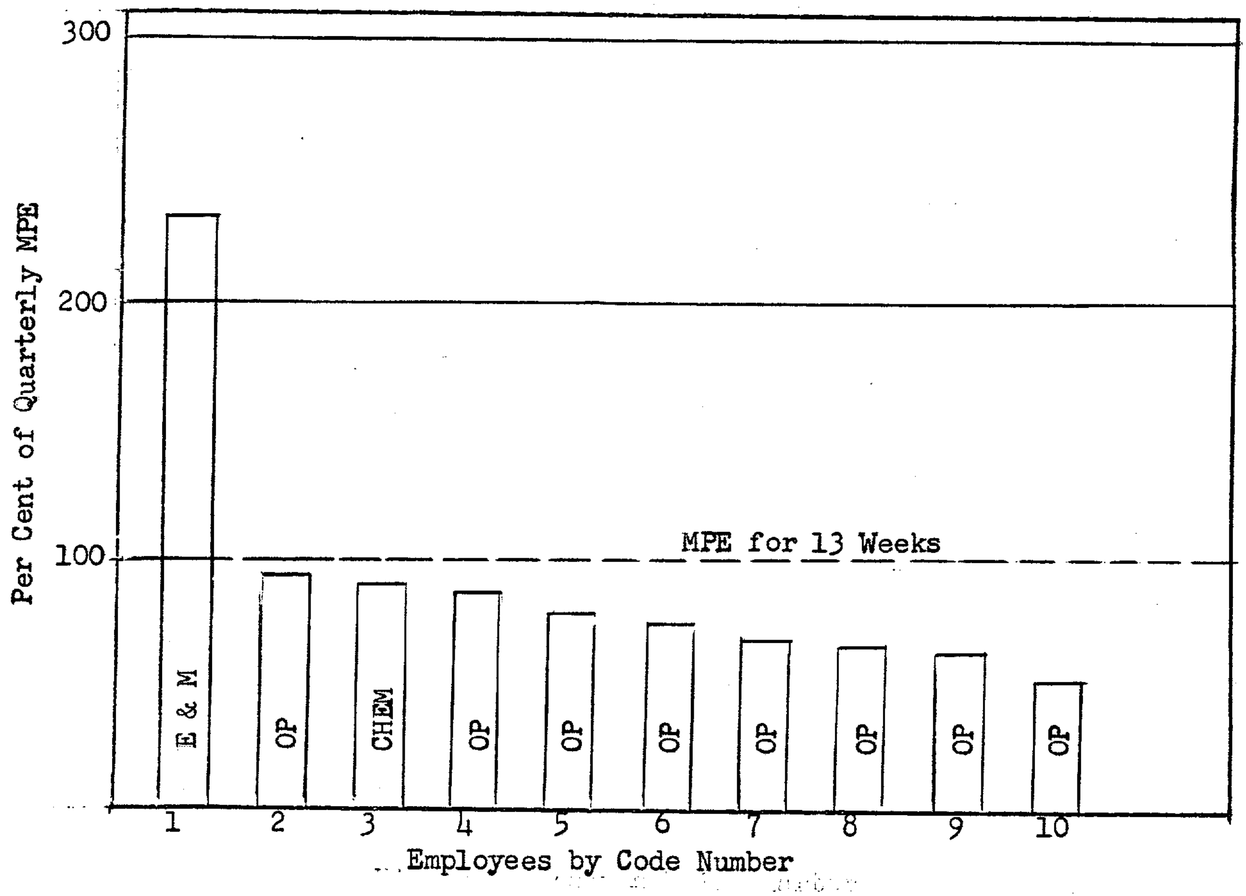


Fig. 5

In only one case did an individual exceed the permissible dose for 13 weeks. The magnitude of this exposure was not considered serious from a health point of view but did require a reassignment of job duties which will cover a period of approximately nine months. In passing, it should be stated that with the exception of this one case, all over-exposures were relatively minor in their nature with the result that only a simple adjustment in the assignment of jobs was indicated.

Part B. Statistical Data

1. Personnel Meters

a. Distribution and Performance of Pocket Meters

	Weekly Av. to Date This Year	Deviation of This Year's Av. from 1953 Weekly Average
Meters distributed	5169	-56.4%
Readable meters	5165	-56.4%
Non-readable meters	3.54	-65.6%
Non-readable pairs	.23	+1050.0%
Off-scale readings	14.0	-65.9%
Off-scale pairs	1.85	-22.3%

b. Distribution and Processing Data of Film Meters

West Portal	1746	-11.9%
East Portal	986	+7.9%
Visitors	390	+10.8%
Ring films, packets, etc.	26	-80.5%
Routine neutron films	197	-10.5%
Special neutron films	7	-65.0%
Calibrations	181	-11.7%
Correspondents	661	-68.5%
Special X-ray films	26	-13.3%
Total films handled	4220	-29.1%

c. Film Meter Data Loss

Badge meters not serviced	33	+31.0%
Films lost	0	-100.0%
Films damaged	0	-100.0%
Total	33	+29.9%

2. Investigations Initiated

a. From Pocket Meter Records

Significant total of 300 mr(ep) or more	.39	-67.2%
Off-scale pairs	1.91	-20.4%
Non-readable pairs	.08	+300.0%
Total	2.38	-34.1%

b. From Film Meter Records	Weekly Av. to date this year
Weekly PTR of 1000 mrep or more, or shield of 600 mr or more	2.15
Questionable PTR of 1000 mrep or more	.92
Lost or damaged films	0
Average >100% of MPE/wk	2.71
Total	5.38

c. Investigation Results	Investigated to Date This Year	Confirmed to Date This Year
Pocket meters	27	12
Film meters	70	40
Total	97	52

Paired off-scale pocket meters investigated to date this year	21
Legitimate number of off-scale pocket meter pairs to date	9
Statistical probability of spurious (paired off-scale) pocket meter readings to date this year	0.24

d. Laundry Decontamination Measurements	Weekly Av. to Date This Year	Dev. of This Yrs Wkly Av. from 1953 Wkly Av.
Garments	3657	-96.0%
Prs. of Shoes for replacement	7	-61.1%
Special items	991	+5.0%
Total	4655	-2.4%

SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

Health Physics personnel answered 13 fire alarms during this period. No radiation or contamination problems were encountered.

Reactors, Accelerators, and Related Physics Surveys:

Three incidents involving air activity and two incidents concerning liquid spills occurred in the 7500 Area.

The incidents concerning air activity were the result of the escape of Xenon and Krypton gases. There was no building or equipment contamination and the radiation exposure to personnel was held to a minimum.

The liquid spills involving fissionable material occurred on March 11th and 18th. The material and equipment contamination that resulted from the spills was cleaned up with very little exposure to personnel.

General Research, Chemistry, and Operations Surveys

Four incidents concerning the accidental release of radioactive materials occurred in the areas listed above. The incidents involved liquid spills and are described in Reports RS-101-54, RS-104-54, RS-105-54, and RS-110-54.

Corrective measures have been taken to prevent recurrence of an incident involving the contamination of a trailer truck used for shipping irradiated uranium slugs from BNL to ORNL. The incident was covered in a report dated February 16, 1954, subject: "Contamination of Brookhaven National Laboratory Trailer."

A large, empty, ORNL isotope carrier was overturned at the Railway Express Office in Oak Ridge on January 19, 1954. A small amount of liquid escaping from the carrier was checked and found to be free of radioactive contamination. The incident was described in a report dated February 3, 1954, subject: "Liquid Spill at Oak Ridge Railway Express Office."

J. C. Hart

J. C. Hart, Chief
Applied Health Physics

Data Compiled By: A. D. Warden, et al
D. M. Davis
J. C. Ledbetter
H. H. Abee

JCH:cs

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For: H. T. Bray, Supervisor
Laboratory Records Dept.
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54-7-103

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APPLIED HEALTH PHYSICS QUARTERLY REPORT

For Period April 5, 1954 - July 4, 1954

2nd Quarter 1954

CLASSIFICATION CANCELLED
DATE 6-10-58
Edgar J. Murphy
CO-ORDINATING ORGANIZATION DIRECTOR
OAK RIDGE NATIONAL LABORATORY
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SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

The highest weekly average activity for the Laboratory Area was 2.4×10^{-9} μc/cc and occurred during the week ending May 3rd. The highest average activity for a single air monitor was 2×10^{-8} μc/cc and was recorded on Constant Air Monitor #2 just south and east of Bldg. 3001. The average air activity for the quarter for all ten air monitors was 1.9×10^{-10} μc/cc which is 53.2 times greater than last quarter and 39.1 times greater than the average for last year. This high average was primarily the result of a single incident of high air activity which occurred on April 29th involving a release of activity from a chemical process in Bldg. 3026-D. The activity was confined to a relatively small area of the plant.

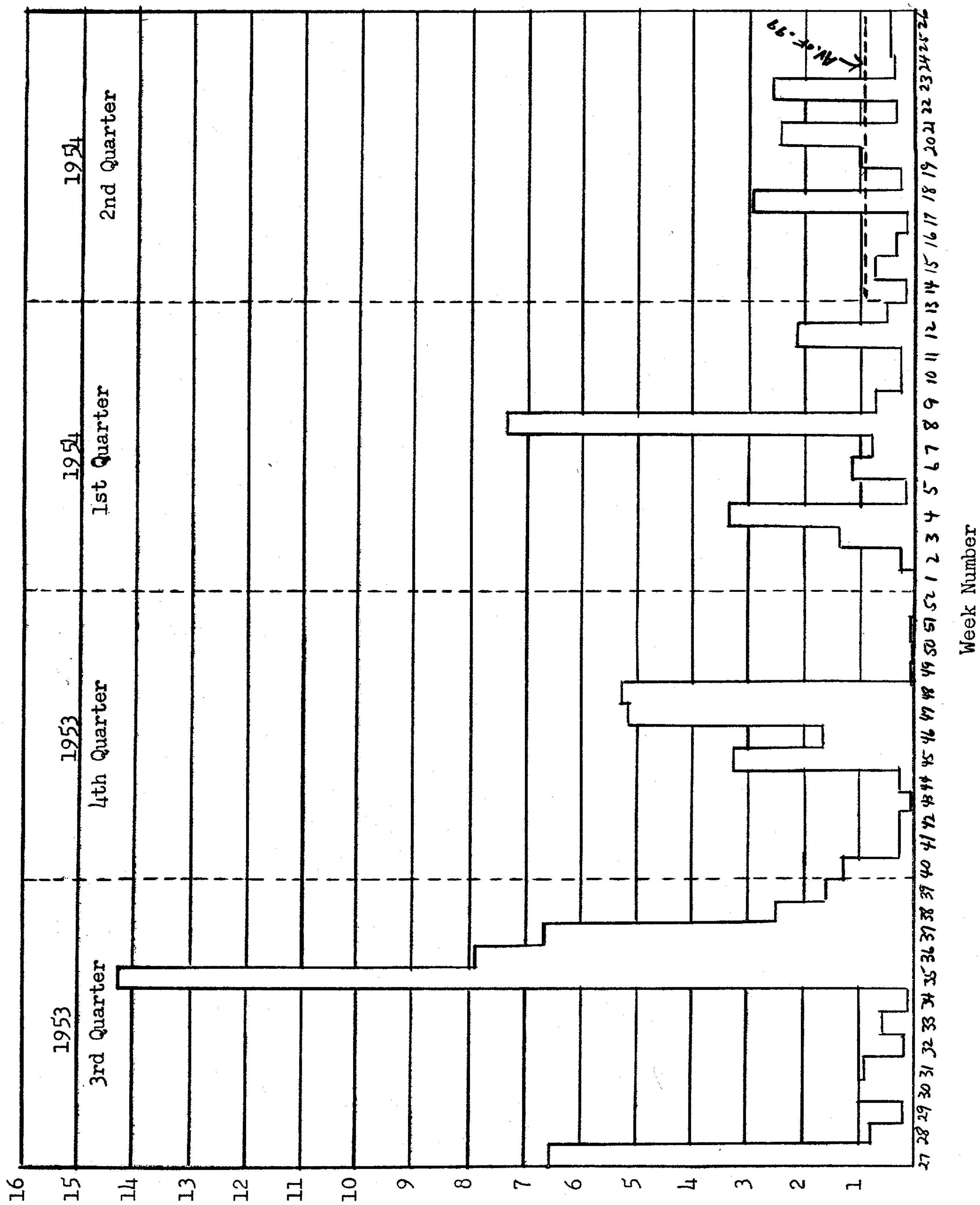
As shown in Fig. 1, the average particle count for the ten constant air monitors was found to be .99 particles per 1000 ft^3 of air sampled. This is 31.2% lower than the average for the first quarter of 1954 and 53.7% below the 1953 average. The highest average particle count occurred during the week ending May 3rd with an average of 3.04 particles per 1000 ft^3. It should be noted that there was a data loss of 3.5 days on two constant air monitors for this week resulting from high air contamination as indicated above. An analysis of air samples taken during this time indicated that the activity was almost 100% iodine. Consequently, it is not likely that the unavailable data would have raised the average appreciably.

Fig. 2 shows that the MPC of 10^{-7} μc/cc was exceeded 65% of the time. The maximum calculated concentration occurred during the week ending May 22nd, with a value of 9.36×10^{-7} μc/cc. Although the total amount of radioactive materials leaving White Oak Lake for the quarter was 21% less than last quarter, the water flow in the Clinch River was at a relatively low level resulting in low dilution factors. The average weekly calculated concentration for the quarter was 2.45×10^{-7} μc/cc, which is 27% higher than the average for last quarter and 169% higher than the average concentration for 1953.

All clothing scheduled for commercial laundries during the quarter was given a beta-gamma check. Alpha checks were made on only those garments not previously checked for alpha. Some 26,966 garments, of which 23,997 were "X" garments -- an "X" garment is one that was found to be below MPL on its initial check, was marked with an indelible X, and after laundering has been re-used in the field -- were monitored. Fig. 3 is a plot of the per cent of the garments checked that were found to be contaminated above MPL. Of the total garments checked during the quarter, 5.6% were found to be contaminated above MPL, and 5.2% of the "X" garments checked were found to be contaminated.

Area background measurements were made and results reported each month. The average monthly background for the quarter on the Laboratory Site was 12.2% greater than the monthly average for 1953.

AIR PARTICULATE ACTIVITY



Weekly Average Particulate Concentration
(Particles/1000 ft^3 of air sampled)

Figure 1

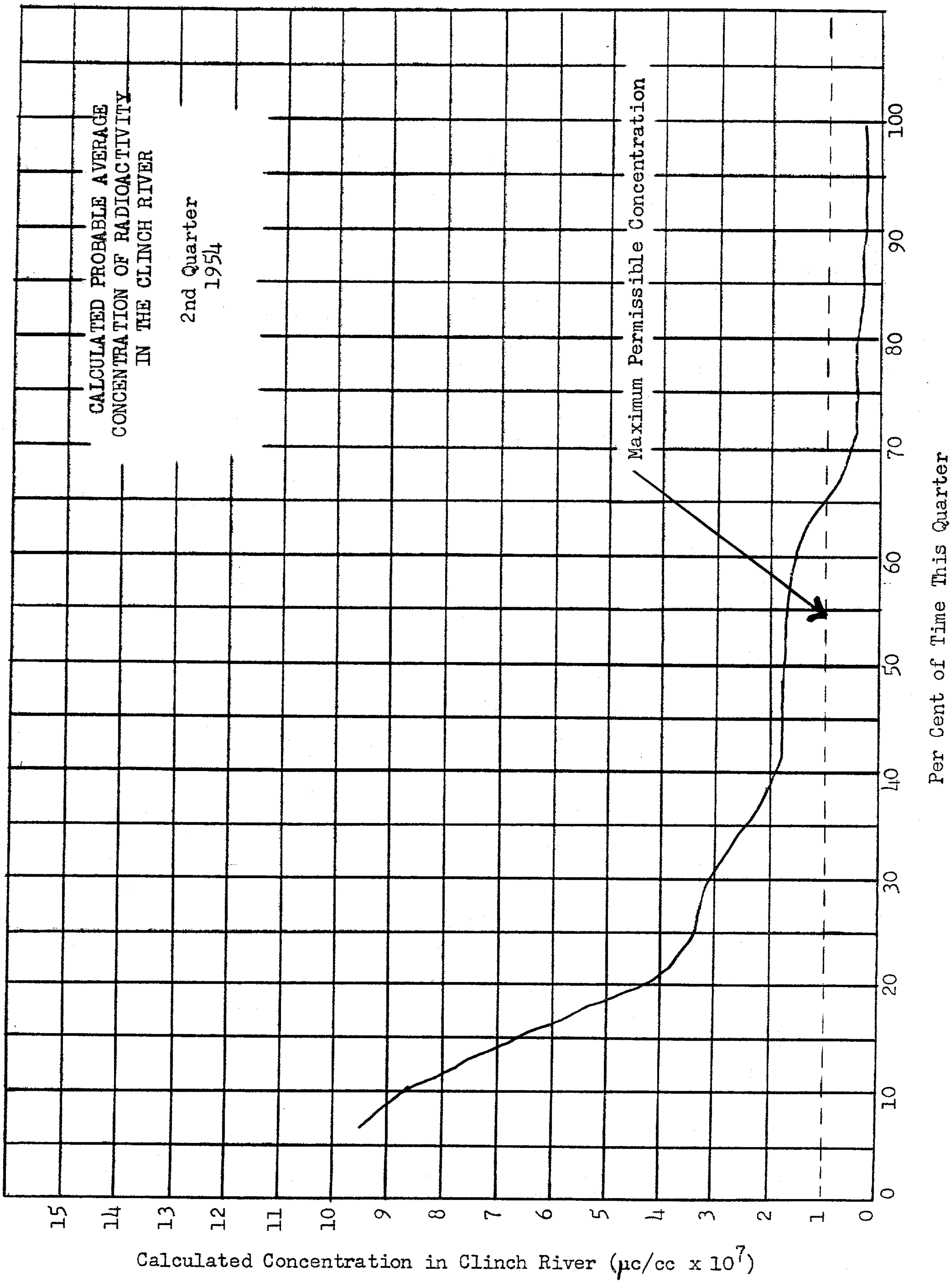

CALCULATED PROBABLE AVERAGE
CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER
2nd Quarter
1954
Maximum Permissible Concentration
Per Cent of Time This Quarter
0 10 20 30 40 50 60 70 80 90 100
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Calculated Concentration in Clinch River (μc/cc x 10^7)

Figure 2

CONTAMINATION CHECK OF GARMENTS GOING TO COMMERCIAL LAUNDRIES

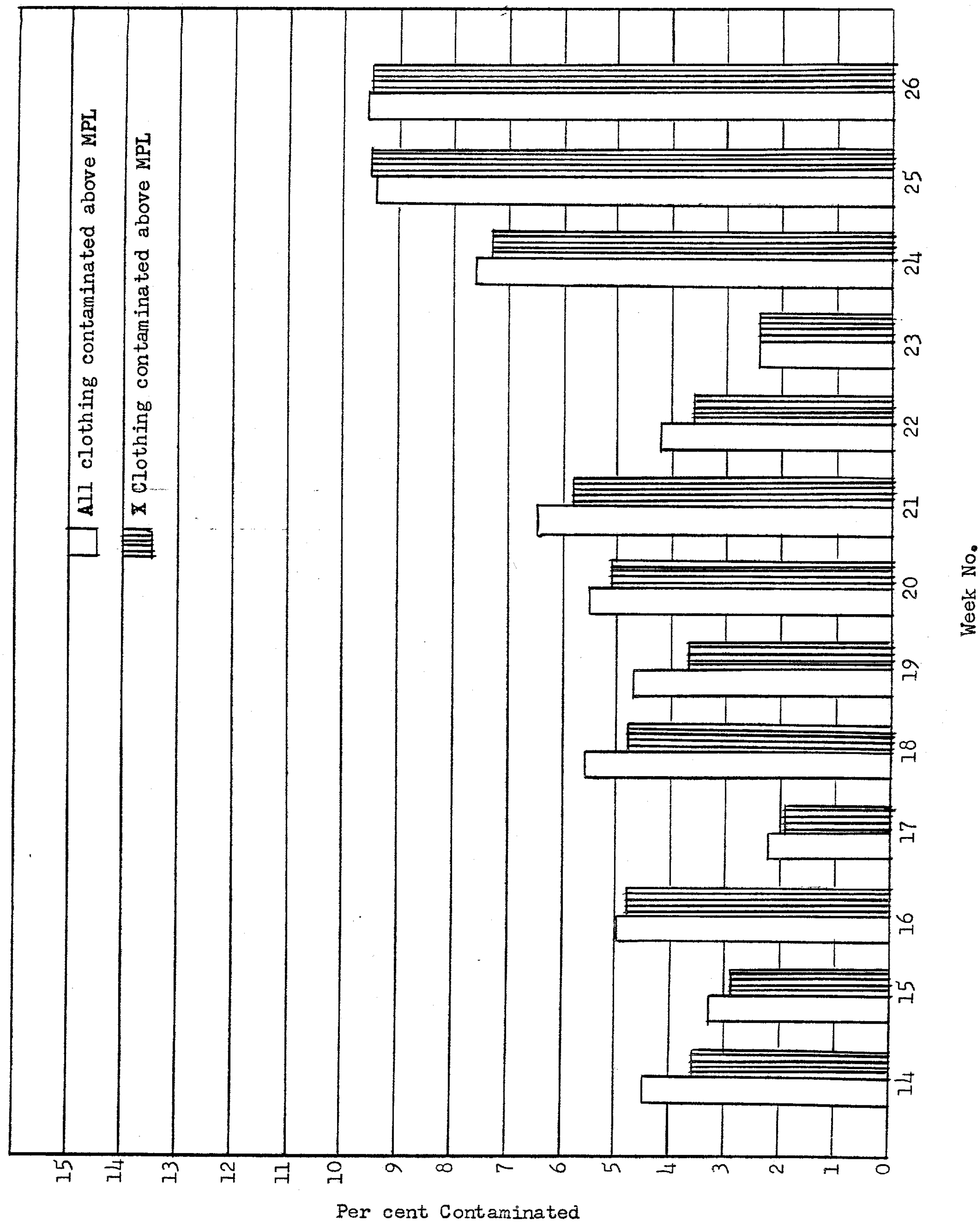


Figure 3

An area of apparent seepage from Lagoon #2 was discovered. The area drained into a small creek which subsequently fed into White Oak Lake. Analysis of the liquid indicated the radioactive content to be primarily Ruthenium.

Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

Station Number	Location	Average Long Lived Activity: Wkly Av. to Date This Year, Conc. x 10^{-13} µc/cc	Average Long Lived Activity: Deviation from 1953 Weekly Average
HP-1	N 3550	56.68	+63.3%
HP-2	S 3001	7865.40	+28294.9%
HP-3	S 1000	14.02	-37.8%
HP-4	W 3513	7.49	-37.5%
HP-5	E 2506	117.25	-59.6%
HP-6	SE 3012	1372.51	+11375.9%
HP-7	W 7001	8.27	-15.0%
HP-8	Rock Quarry	2.40	-79.6%
HP-9	A-10 Site	7.27	-35.8%
HP-10	E 2074	24.91	-22.2%
Average all stations		947.62	
Deviation of this year's average long lived activity to date from last year's average			+1942.3%

2. Particulate Studies

a. USPHS Filters

Number	Location	Weekly Average to Date This Yr. Particles per 1000 ft^3	Deviation of Wkly Av. to Date This Year from Wkly Av. Last Year
A-1	3026	1.51	-58.9%
A-2	3003	0.18	-74.3%
A-3	1000	0.31	-55.7%
A-4	7001	0.08	-73.3%
Average all stations		0.52	
Deviation of this year's weekly average to date from weekly average last year			-62.2%

b. CAM Filters

Number	Location	Weekly Average to Date This Yr. Particles per 1000 ft^3	Deviation of Wkly Av. to Date This Year from Wkly Av. Last Year
HP-1	N 3550	1.85	-12.3%
HP-2	S 3001	1.82	-4.8%
HP-3	S 1000	0.56	-72.4%
HP-4	W 3513	0.31	-85.4%
HP-5	E 2506	5.02	+5.2%
HP-6	SE 3012	0.87	-46.6%
HP-7	W 7001	0.26	-82.1%
HP-8	Rock Quarry	0.25	-86.3%
HP-9	A-10 Site	0.38	-75.2%
HP-10	E 2075	0.84	-59.0%
Average		1.22	

Deviation of this year's weekly average to date from weekly average last year -43.0%

3. Meteorological Data

a. Rainfall

Total this year	29.67 inches
Normal yearly rainfall	52.04 inches
Deviation from normal seasonal rainfall	+22.0%

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin Beta	White Oak Lake Beta
Weekly Av. to date this year	3.84	9.16
Deviation from 1953 weekly average	-28.6%	+56.8%

b. Submersion Data

	Settling Basin Beta mrep/hr	Settling Basin Gamma mr/hr	Settling Basin Total mr(ep)/hr	White Oak Lake Beta mrep/hr	White Oak Lake Gamma mr/hr	White Oak Lake Total mr(ep)/hr
Weekly Av. to Date This Yr.	0.335	0.272	0.607	0.033	0.024	0.057
Dev. from 1953 wkly average	-4.8%	-38.5%	-23.6%	0.0%	-4.0%	-1.7%

c. Plutonium Discharged

	Settling Basin		White Oak Lake	
	Conc. x 10^{-9} µg/cc	Total mg Plutonium	Conc. x 10^{-9} µg/cc	Total mg Plutonium
Weekly Av. to date this year	806.7	10.426	30.0	27.029
Deviation from 1953 weekly average	-67.3%	-73.0%	-77.7%	+3.5%

d. Probable Average Concentration in Clinch River Below White Oak Creek*

Weekly average to date this year	2.20 x 10^{-7} uc/cc
Deviation from 1953 weekly average	+142%

*Calculated using as a dilution factor the ratio of White Oak Lake discharge to the flow of Clinch River.

SECTION II. ASSAYS-INSTRUMENTS

Part A. Salient and Non-Routine Items

A preliminary report describing a method of determining, by urinalysis, internal radiation exposures immediately following inhalation of airborne radioactivity has been submitted.

Studies relative to the application of the copper and cadmium filters, as used in the film badge, for determining neutron exposures are in progress. This study is with the cooperation of the Radiation Survey Section.

Further work on the Taplin dosimeter is dependent on receipt of a fresh supply of dosimeters.

A high frequency radio transmitter and receiver with associated components for relaying information from remote radiation monitoring devices have been constructed and bench tested. Operation is satisfactory.

Designing and testing of proposed minor alterations to the physical structure and filter system of the present film badge meter are in progress. Pilot models have been fabricated and are undergoing tests.

Tests have been performed with duPont type 555 and Eastman type 5302 films. The results indicate that these films may be practical in personnel monitoring.

Methods have been devised and calibration set-ups modified with a view toward increasing the accuracy and efficiency in interpreting film exposures.

Effective July 1st a new group, Environs, was formed within the Assays-Instruments Section. This group will be under the supervision of T. J. Burnett. Other members of this group are J. M. Davis, W. D. Cottrell, and A. C. Butler.

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services This Quarter

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Per Week Alpha	Beta	Units/Count (unit = 2/3 min.)	Average Total Units Per Week for 1954
Smears		2547	2421	1	4968
Air Samples	214	317	196	3	2181
Waste Disposal			58	4	222
ERDL			30	4	120
Chemical Research			139	4	557
Area Monitoring			17	4	68
Decay and Absorp-	135			2	270
tion Curves			238	4	950
Off-Area Monitoring			18	4	72

Average number of units per week	9408
Deviation of the weekly average this quarter from weekly average of 1953	-21.6%
Total units handled to date this year	233870
Deviation of weekly average to date this year from weekly average of 1953	-8.3%

b. Chemical Analysis

	Average Number Per Week
Pu	15.2
U	13.3
Sr, Y, Pb, Gross β and γ	12.5
FP	19.5
Off-Area Rain Water and Fall Out	49.0
Pu from Settling Basin and Lake	3.7
Monthly Composites	2.3

Average number of samples per week	115.4
Deviation of the weekly average this quarter from weekly average of 1953	+64.9%
Total samples handled to date this year	2623
Deviation of weekly average to date this year from weekly average of 1953	+44.1%

2. Calibration Unit

a. Film Routine

Average number of films calibrated per week	291
Deviation of the weekly average this quarter from the weekly average of 1953	-46%
Total films calibrated	3784
Deviation of 1954 weekly average from weekly average of 1953	-39%

b. Instrument Routine

Average number of instruments calibrated per week	107
Deviation of the weekly average this quarter from the weekly average of 1953	-12%
Total instruments calibrated	1393
Deviation of 1954 weekly average from weekly average of 1953	-7.4%

3. Source Inventory

	On Hand
a. Radium	14
b. Po-Be	1
c. Cesium	1
d. Uranium discs	68

4. Portable Instruments Repaired

a. Average number of instruments repaired per week	41
b. Deviation of the weekly average this quarter from weekly average of 1953	0%
c. Total instruments repaired during 1954	1146
d. Deviation of 1954 weekly average to date this year from weekly average of 1953	+7%

5. Operation of Fixed and Semi-Portable Instruments*

		1	2	3	4	5	6
a.	Constant Air Monitors	3860	2046	1814	217	47%	5.6%
b.	Monitrons	4195	2529	1666	170	40%	4.1%
c.	Hand and Foot Ctrs.	720	293	427	25	59%	3.5%
d.	A.C.Poppies (Alpha & Beta-Gamma)	1255	443	812	23	65%	1.8%
e.	Scalers (including alpha counters)	1830	938	892	54	49%	2.9%
f.	Precipitrons	535	273	262	1	49%	0.2%
g.	Friskers	515	241	274	63	53%	12.2%
h.	Filtrons	475	112	363	0	75%	0.0%
i.	Disc Air Samplers	390	168	222	0	57%	0.0%

*Explanation for Column Headings:

1. Total number of "Instrument Days" where an "Instrument Day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operational reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Per cent of "Instrument Days" not reported.
6. Per cent of "Instrument Days" instrument reported out of service.

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

Monitoring of ORNL employees at the Y-12 area was assumed in June 1954. One technician was transferred from the Y-12 Health Physics Section to the X-10 Personnel Monitoring Section to assist in handling added work load.

Data from IBM for 1953 was reported on June 29, 1954.

Nine cases of significant exposures were identified as diagnostic X rays.

One General Electric employee spent two weeks observing neutron dosimetry techniques.

Personnel exposures did not differ significantly from last quarter. Fig. 4 is a breakdown by Laboratory Divisions showing the number of significant exposures and the number of cases where the weekly MPE and the quarterly MPE is exceeded. The greatest number of exposures were sustained by the Operations Division.

Fig. 5 is a breakdown by Laboratory Divisions showing the number of overage weeks and the number of persons involved.

Fig. 6 is a plot showing the exposure total of the ten employees who sustained the highest exposures during the quarter. In three cases individuals exceeded the permissible dose for 13 weeks. However, since the highest exposure exceeded the permissible dose for 13 weeks by only 13%, the magnitude of the exposures was not considered serious from a health point of view.

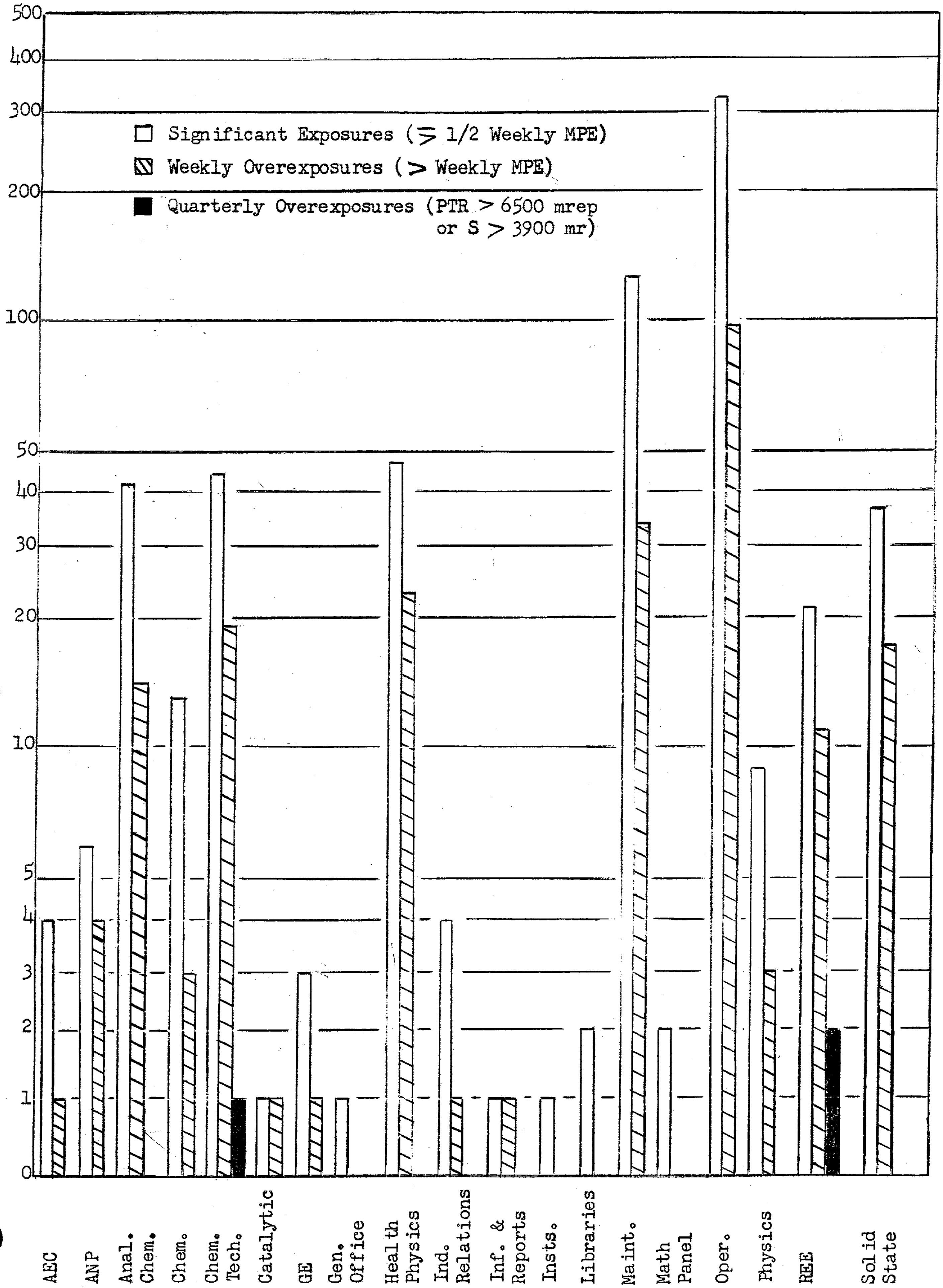

Significant Exposures (≥ 1/2 Weekly MPE)
Weekly Overexposures (> Weekly MPE)
Quarterly Overexposures (PTR > 6500 mrep
or S > 3900 mr)
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
0
AEC
ANP
Anal. Chem.
Chem.
Chem. Tech.
Catalytic
GE
Gen. Office
Health Physics
Ind. Relations
Inf. & Reports
Insts.
Libraries
Maint.
Math Panel
Oper.
Physics
REE
Solid State

Figure 4

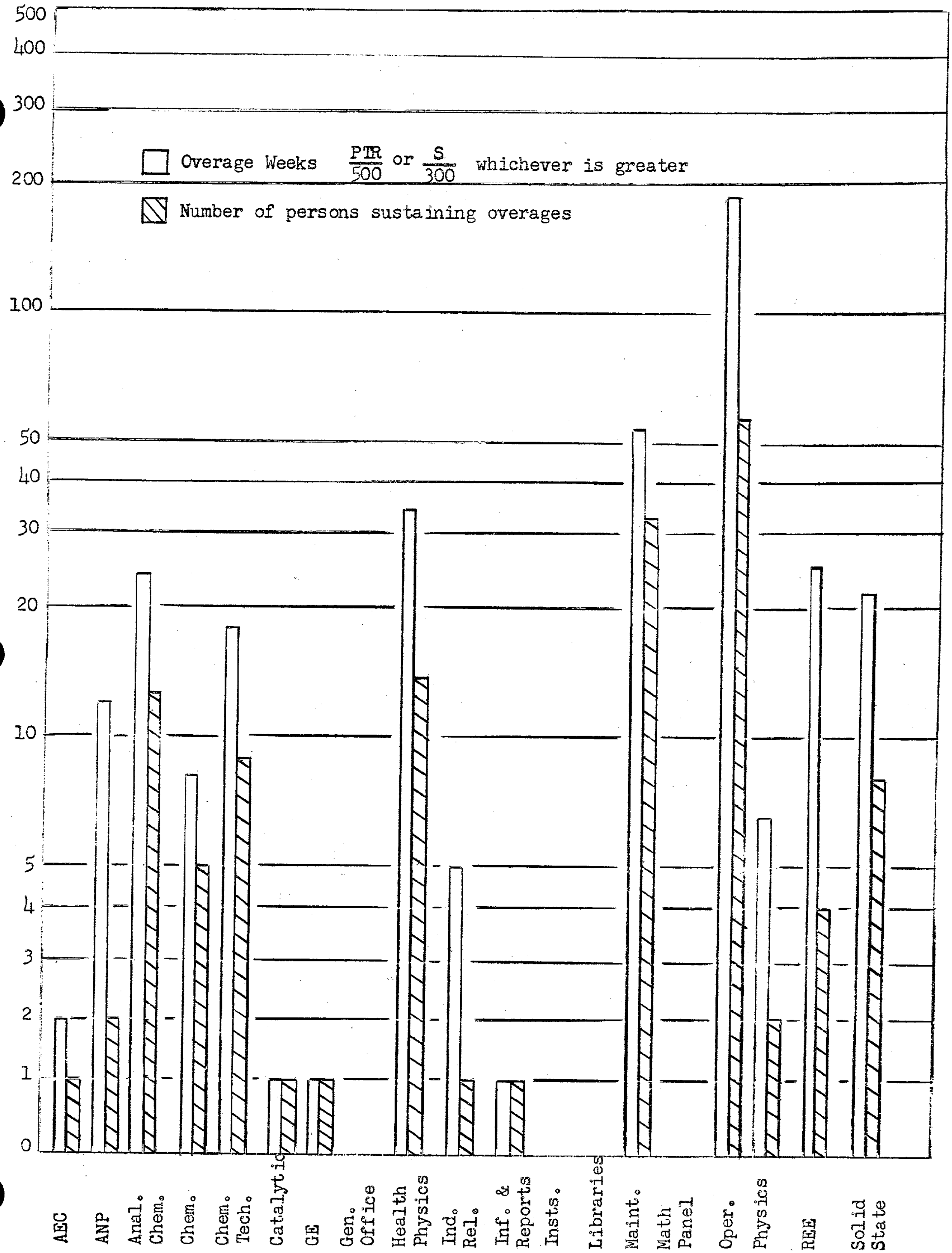

500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
0
Overage Weeks $\frac{PTR}{500}$ or $\frac{S}{300}$ whichever is greater
Number of persons sustaining overages
AEC
ANP
Anal. Chem.
Chem.
Chem. Tech.
Catalytic
GE
Gen. Office
Health Physics
Ind. Rel.
Inf. & Reports
Insts.
Libraries
Maint.
Math Panel
Oper.
Physics
REE
Solid State

Figure 5

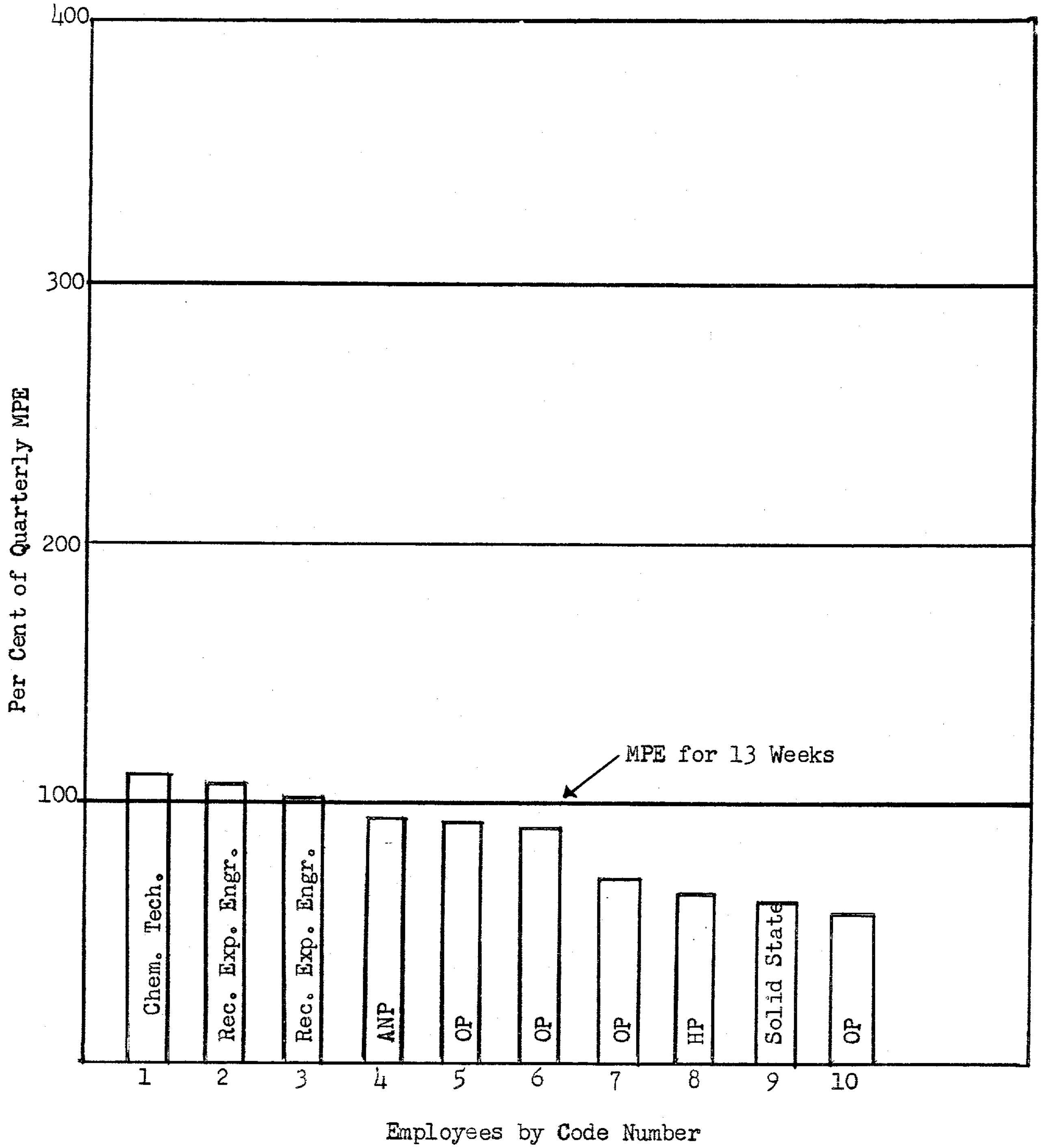

400
300
200
100
Per Cent of Quarterly MPE
MPE for 13 Weeks
Chem. Tech.
Rec. Exp. Engr.
Rec. Exp. Engr.
ANP
OP
OP
OP
HP
Solid State
OP
1
2
3
4
5
6
7
8
9
10
Employees by Code Number

Figure 6

Part B. Statistical Data

1. **Personnel Meters**

a. Distribution and Performance of Pocket Meters

	Weekly Av. to Date This Year	Deviation of This Year's Av. from 1953 Weekly Average
Meters distributed	4869	-58.9%
Readable meters	4867	-58.9%
Non-readable meters	3.84	-61.4%
Non-readable pairs	.15	+650.0%
Off-scale readings	17	-58.5%
Off-scale pairs	1.88	-21.0%

b. Distribution and Processing Data of Film Meters

West Portal	1680	-15.2%
East Portal	981	+7.3%
Visitors	428	+21.6%
Ring films, packets, etc.	26	-80.5%
Routine neutron films	191	-13.2%
Special neutron films	103	+415.0%
Calibrations	171	-16.6%
Correspondents	434	-79.3%
Special X-ray films	21	-30.0%
Total films handled	4060	-31.8%

c. Film Meter Data Loss

Badge meters not serviced	39	+54.8%
Films lost	0	-100.0%
Films damaged	0	-100.0%
Total	39	+53.5%

2. Investigations Initiated

a. From Pocket Meter Records

Significant total of 300 mr(ep) or more	.19	-84.0%
Off-scale pairs	1.88	-21.7%
Non-readable pairs	.03	+50.0%
Total	2.11	-41.6%

b. From Film Meter Records

	Weekly Av. to Date This Year
Weekly PTR of 1000 mrep or more, or shield of 600 mr or more	2.65
Questionable PTR of 1000 mrep or more	.73
Lost of damaged films	.03
Average > 100% of MPE/wk	2.80
Total	7.00

c. Investigation Results

	Investigated to Date This Year	Confirmed to Date This Year
Pocket meters	50	23
Film meters	192	94
Total	242	117

Paired off-scale pocket meters investigated to date this year	43
Legitimate number of off-scale pocket meter pairs to date	20
Statistical probability of spurious (paired off-scale) pocket meter readings to date this year	0.78

d. Laundry Decontamination Measurements

	Weekly Av. to Date This Year	Dev. of This Year's Weekly Av. from 1953 Weekly Average
Garments	3644	-4.3%
Prs. of Shoes for Replacement	6.80	-62.2%
Special Items	1012	+7.2%
Total	4663	-2.3%

SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

On April 1, the responsibility for Health Physics coverage for ORNL functions at the Y-12 installation was transferred to the ORNL Health Physics Division.

Health Physics personnel answered 15 fire alarms during this quarter. No radiation or contamination problems were encountered.

Reactors, Accelerators, and Related Physics Surveys:

The major portion of dismantling the HRE was accomplished during this period. Despite the necessity of working in high fields of radiation during dismantling work, only one slight overexposure was accumulated.

On April 21st, a liquid spill involving mixed fission products occurred in Bldg. 3025. Contamination of hallways and change rooms necessitated extensive decontamination proceedings. Details concerning this incident are included in a report dated April 26th, subject: "Contamination in Bldg. 3025."

In a cooperative project the Section worked with representatives from the University of California in exposing chemical dosimeters to neutrons. The dosage range covered varied from approximately one hundred to thirty-two hundred rep. Fast neutron exposures were made with the eighty-six inch cyclotron in the Y-12 area. Thermal neutron exposures were made in the vertical animal tunnel in the graphite reactor. The results are being tabulated by G. V. Taplin and his associates, of the U. of Calif.

General Research, Chemistry, and Operations Surveys:

Decontamination of the area and buildings surrounding Bldg. 3026-D following the April 29th incident covered a period of several weeks. Details are covered in a report dated May 17, 1954, subject: "Incident in Bldg. 3026-D."

Results of air and surface contamination samples taken in Bldg. 3505 since the advent of certain projects started in early March indicate that levels of airborne and surface contamination have, on occasions, exceeded the maximum permissible allowable limit. Details concerning results of the sampling program are contained in two reports by C. L. Selander.

On May 26th, certain sections of the floors in Bldg. 3019 became contaminated. An account of the incident is recorded in a report dated May 27th, subject: "Unusual Incident, Room 211 and Room 502, Bldg. 3019."

On April 8th, approximately 200 square feet of street surface near the west entrance to Bldg. 4505 became contaminated with solution containing U^{238}. The incident is covered in a report dated April 20th, subject: "Waste Tank Truck Leak Incident."

Air and surface contamination checks in Bldg. 3503 during the pellet making operation indicate that the levels of contamination frequently exceeded the maximum permissible level. A study of the conditions is recorded in a report dated June 24th, subject: "Uranium Contamination of Bldg. 3503."

Y-12 Group

On May 26th, a mechanical failure in one of the experimental set-ups in Bldg. 9213 produced a major radiation hazard. A detailed account of the Health Physics functions during and after the incident is covered in a report by R. O. Wollan, dated June 22, 1954, subject: "Radiation Excursion in Bldg. 9213."

J C Hart

J. C. Hart, Chief
Applied Health Physics

Data Compiled by: A. D. Warden, et al
D. M. Davis
J. C. Ledbetter
H. H. Abee

JCH:cs

[redacted]

Oak Ridge National Laboratory

Health Physics Division

ORNL
CENTRAL FILES NUMBER
54-10-169

APPLIED HEALTH PHYSICS QUARTERLY REPORT

For Period July 5, 1954 - October 4, 1954

#34

3rd Quarter 1954

CLASSIFICATION CANCELLED
DATE 1-23-58
Edgar J. Murphy
CO-ORDINATING ORGANIZATION DIRECTOR
OAK RIDGE NATIONAL LABORATORY
AUTHORITY DELEGATED BY AEC 9-18-57

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SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

Based on an average of the ten constant air monitors, air activity showed a notable decrease from that of last quarter. The weekly average value for this quarter was 7.8×10^{-13} μc/cc which is 99.6% less than last quarter and 83.2% less than the weekly average for last year. (The higher value for last quarter was determined to be the result of a spill in Building 3026-D.) The highest average activity for a single week was 12.9×10^{-13} μc/cc and occurred during the week ending July 6. The highest average activity recorded on a single air monitor was 51.8×10^{-13} μc/cc. This also occurred during the week ending July 6.

The average radioactive particle count for the ten constant air monitors continued at a low level. A running plot, Fig. 1, p.2, shows the average for the quarter as 0.7 particles per 1000 ft^3 of air sampled. This average is 29.3% lower than the average for last quarter and 67.3% below the 1953 weekly average. Constant Air Monitor No. 1, just north of Building 3550, showed the highest particle count for a given week with an average of 14.77 particles per 1000 ft3 of air sampled. The highest weekly average for all ten constant air monitors was 2.84 particles per 1000 ft^3 of air. Both instances occurred during the week ending September 7 and may be attributed to a process going on in Building 3550 (Memo to J. C. Hart from G. R. Patterson, dated September 9, 1954).

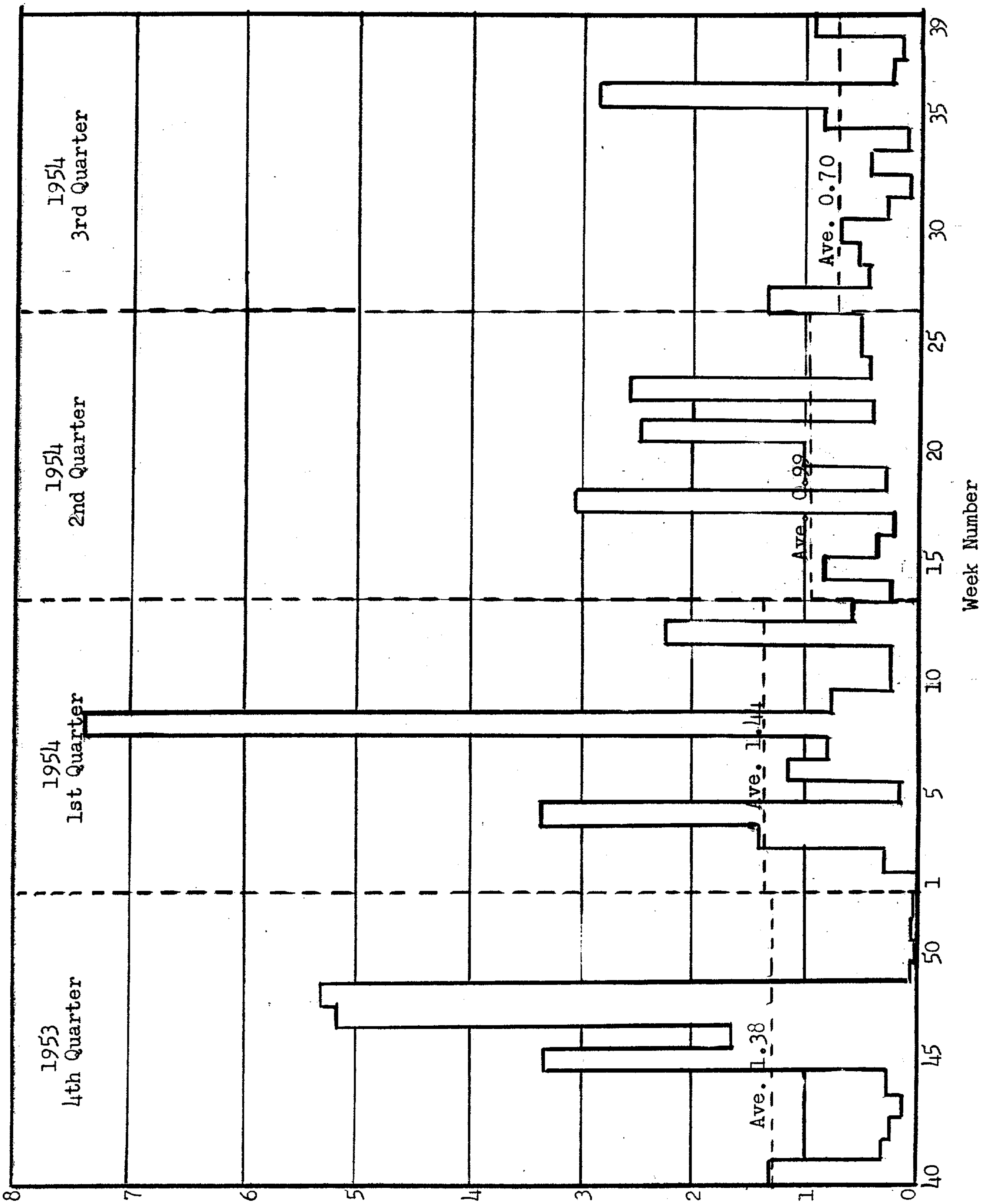
Area Monitoring and General Surveys personnel did special air sampling during the week ending July 26 at W-9 tank in the tank farm. The purpose of this sampling was to test the efficiency of a fiber glass filter placed in the tank vent. Results indicated that the filter was effective in reducing the air contamination from W-9 vent by at least a factor of 100.

Liquid waste discharges from White Oak Lake were at a relatively low level for most of the quarter, with the average weekly curies discharge being 41.7% below that of last quarter. Fig. 2, p. 3, shows that the calculated probable average concentration in the Clinch River exceeded the MPC value of 10^{-7} μc/cc only 25% of the time. This is a decided improvement over the value of 65% reported last quarter. The maximum calculated value was 1.68×10^{-7} μc/cc and occurred during the week ending August 14. The average weekly calculated concentration for the quarter was 0.81×10^{-7} μc/cc which is 66.9% less than that for the last quarter and 28.3% less than the average concentration for 1953.

Monitoring of clothing going to commercial laundries continued during the quarter. A total of 31,249 garments were checked.

Figure 1

AIR PARTICULATE ACTIVITY
Average of 10 CAM's



Weekly Average Radioparticulate Concentration
(Particles/1000 ft^3 of air sampled)

Figure 2

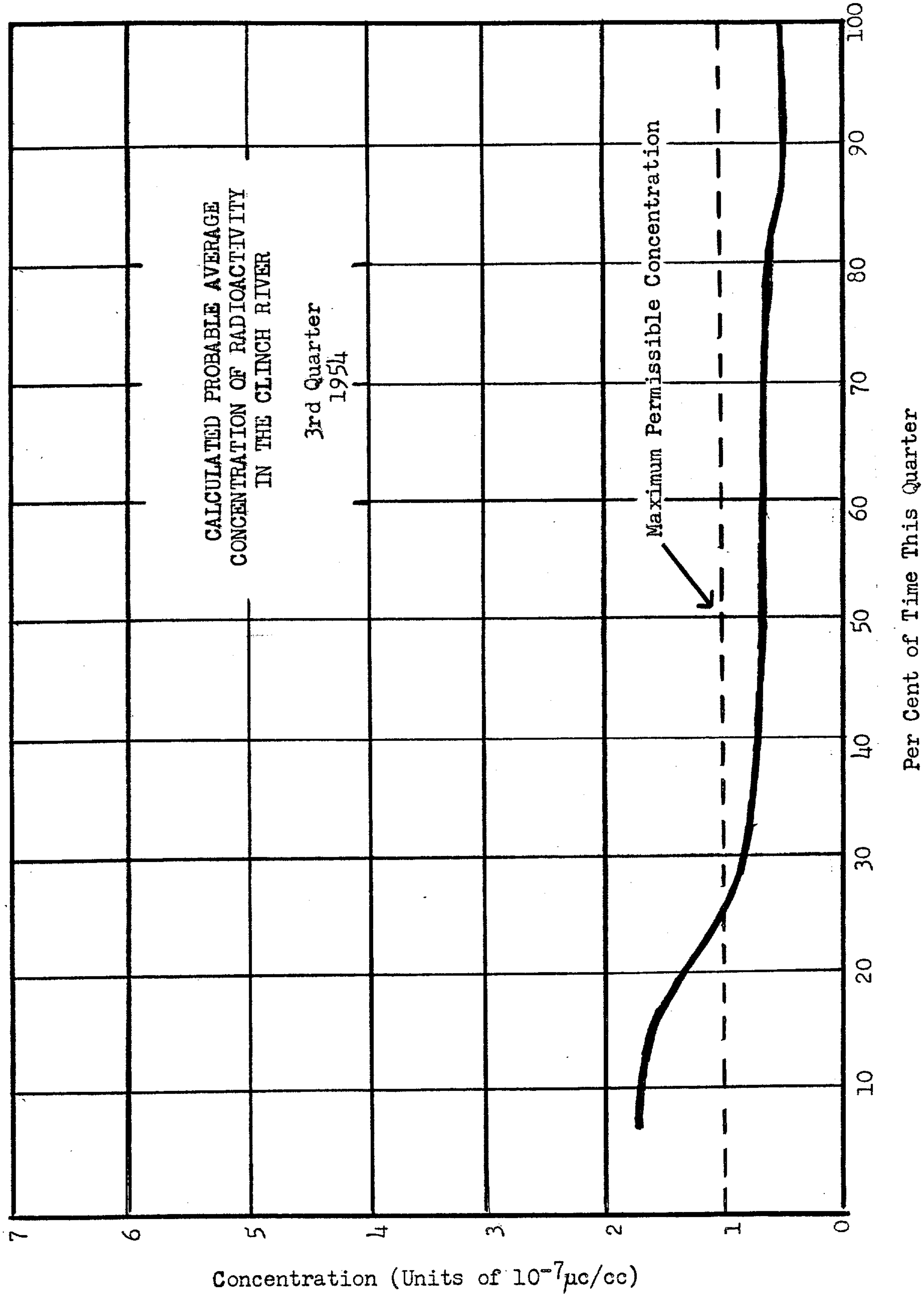

CALCULATED PROBABLE AVERAGE
CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER
3rd Quarter
1954
Maximum Permissible Concentration
Per Cent of Time This Quarter
0
10
20
30
40
50
60
70
80
90
100
Concentration (Units of 10⁻⁷μc/cc)
0
1
2
3
4
5
6
7

Fig. 3, p. 5, is a plot of the percent of the garments checked each week that were found to be contaminated above MPL. It is noteworthy that the trend in garment contamination for the quarter is in a downward direction. Of the total checked for the entire quarter, 5.1% were found to be contaminated as compared to 5.6% for last quarter.

Results on area background measurements were reported each month with the average monthly background for the quarter on the Laboratory site being 39% greater than that for 1953.

Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

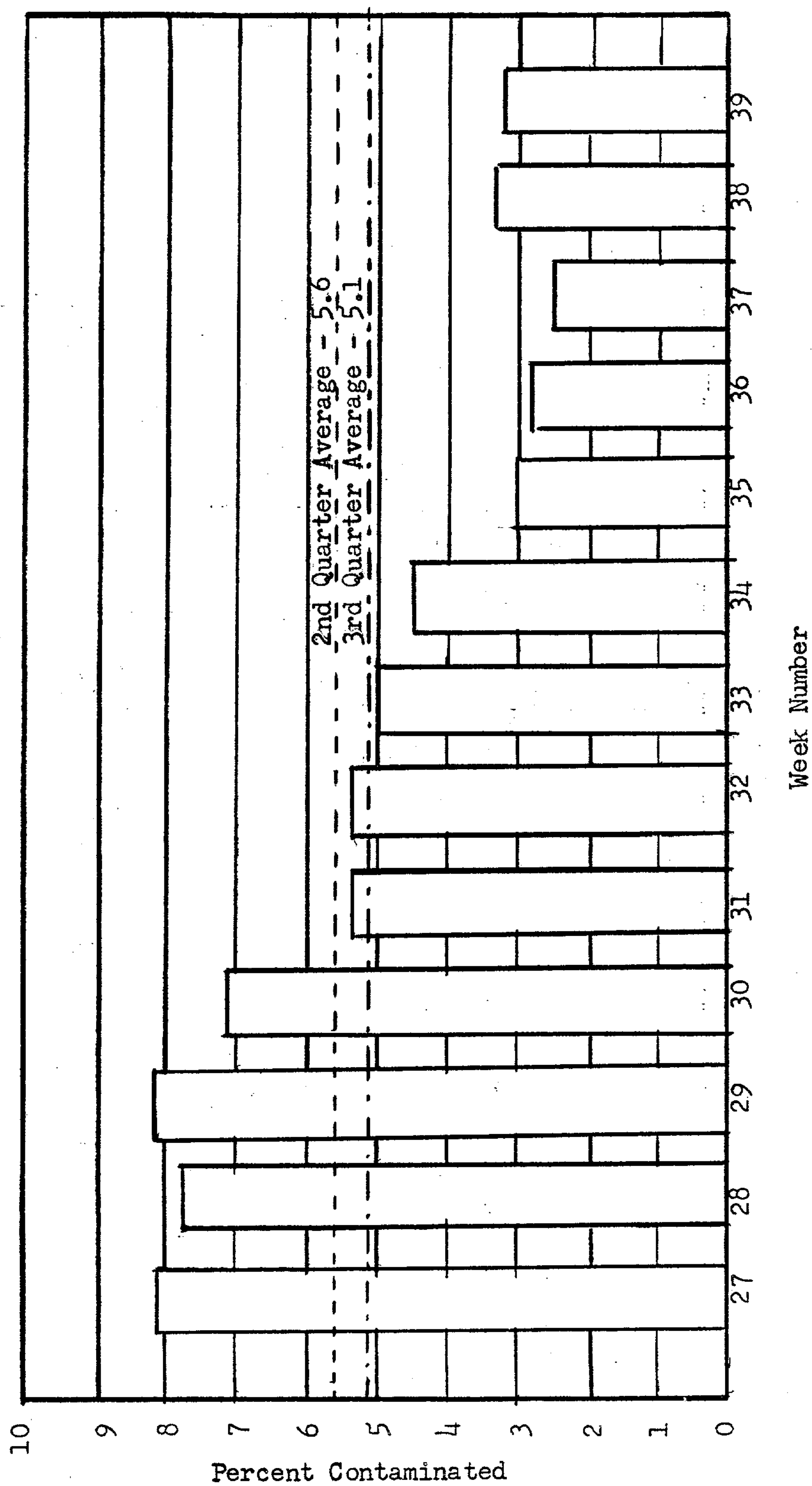
Station Number	Location	Average Long Lived Activity: Wkly. Av. to Date This Year, Conc. x 10^{-13} µc/cc	Average Long Lived Activity: Deviation from 1953 Weekly Average
HP-1	N 3550	42.34	+22.0%
HP-2	S 3001	6169.25	+22171.7%
HP-3	S 1000	11.60	-48.5%
HP-4	W 3513	6.14	-48.8%
HP-5	E 2506	84.63	-70.9%
HP-6	SE 3012	916.42	+7562.4%
HP-7	W 7001	7.68	-21.1%
HP-8	Rock Quarry	3.23	-72.5%
HP-9	A-10 Site	5.99	-47.1%
HP-10	S 2007	18.36	-42.7%
Average		726.56	

Deviation of this year's average long lived activity to date from last year's average +1465.9%

Figure 3

CONTAMINATION CHECK OF GARMENTS

GOING TO COMMERCIAL LAUNDRIES



2. Particulate Studies

a. USPHS Filter

Number	Location	Weekly Average To Date This Year Particles per 1000 ft^3	Deviation of Weekly Ave. to Date This Year from Weekly Ave. Last Year (%)
A-1	3026	1.41	-61.6
A-2	3003	0.15	-78.6
A-3	1000	0.28	-60.0
A-4	7001	0.06	-80.0
A-5	3550	4.80	-36.2
Average		1.34	

Deviation of this year's weekly average to date from weekly average last year -48.1%

b. CAM Filters

Number	Location	Weekly Average To Date This Year Particles per 1000 ft^3	Deviation of Weekly Ave. to Date This Year from Weekly Ave. Last Year (%)
HP-1	N 3550	1.69	-19.9
HP-2	S 3001	1.38	-27.7
HP-3	S 1000	0.46	-77.3
HP-4	W 3513	0.58	-72.8
HP-5	E 2506	3.84	-19.5
HP-6	SE 3012	0.70	-57.1
HP-7	W 7001	0.22	-84.8
HP-8	Rock Quarry	0.20	-89.1
HP-9	A-10 Site	0.33	-78.4
HP-10	S 2007	0.67	-67.3
Average		1.01	

Deviation of this year's weekly average to date from weekly average last year -52.8%

3. Meteorological Data

a. Rainfall

Total this year	36.44 inches
Normal yearly rainfall	52.04 inches
Deviation from normal seasonal rainfall	+3.7%

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin Beta	White Oak Lake Beta
Weekly Ave. to date this year	3.84	9.16
Deviation from 1953 weekly average	-32.1%	+31.3%

b. Submersion Data

	Settling Basin			White Oak Lake		
	Beta mrep/hr	Gamma mr/hr	Total mr(ep)/hr	Beta mrep/hr	Gamma mr/hr	Total mr(ep)/hr
Weekly ave. to date this year	0.380	0.455	0.835	0.036	0.027	0.063
Deviation from 1953 weekly average	+8.0%	+2.9%	+5.2%	+9.1%	+8.0%	+8.6%

c. Plutonium Discharged

	Settling Basin		White Oak Lake	
	Conc. x 10^{-9} µg/cc	Total mg Plutonium	Conc. x 10^{-9} µg/cc	Total mg Plutonium
Weekly ave. to date this year	887.2	12.091	35.8	19.533
Deviation from 1953 weekly average	-64.1%	-68.7%	-73.4%	-25.2%

d. Probable Average Concentration in Clinch River Below White Oak Creek using as a dilution factor the ratio of White Oak Lake discharged to the flow of Clinch River.

Weekly Average to Date This Year	1.74×10^{-7} μc/cc
Deviation from 1953 Weekly Average	+91.2%

SECTION II. ASSAYS - INSTRUMENTS

Part A. Salient and Non-Routine Items

The data collection phase of the 1954 River Survey was essentially completed. Gamma-ray intensity measurements were made at the surface of the bottom sediment as far downstream as Chickamauga Dam. In addition, samples of the sediment were collected for radioactive assay. Background measurements were made in Norris Lake.

Two flights were made for the Aerial Background Survey program for the purpose of checking the sensitivity of the instruments and to determine the relative background radiation levels at various distances from the Laboratory site. Since clearances had not been obtained, the flights did not include patterns over the ORNL area.

The renovation and modification of Building 2008 which will include the Environmental Studies Group is near completion. A storage room in Building 2052 has been completed and the laboratory should be ready for occupancy the first part of October.

Several metals are being investigated for use in the film badge meter as neutron dose indicators. Tin, with a cross section of three to six barns, seems to be the best metal tested thus far since it shows a fairly uniform response over the whole neutron spectrum.

P. E. Brown and E. D. Gupton presented papers at the September meeting of the Cincinnati Radiological Society. Brown discussed: "Determination of Internal Dose from Inhaled Sr^{90}," and Gupton discussed, "Method of Determining Exposures to Mixed Radiation."

D. M. Davis attended the regional Radiological Defense Conference for Region 3 in Atlanta and presented a paper: "Calibration of Portable Survey Instruments."

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services This Quarter

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Per Week Alpha	No. Counts Performed Per Week Beta	Units Per Count*	Average Total Units/Wk for 1954
Smears	194.6	2981.5	2318.6	1	5300
Air samples		266.4	186.1	3	1862
Sanitary eng. research			20	4	80
Applied radiobiology			194.4	4	765
Area monitoring			19	4	76
Decay & absorption curves	56.4		138.9	2	556
Environs			36.5	4	146

Average number of units per week	8898
Deviation of the weekly average this quarter from 1953 weekly average	-25.4%
Total units handled to date this year	345900
Deviation of weekly average to date this year from 1953 weekly average	-26.0%

* Unit = 2/3 min.

b. Chemical Analysis

	Average Number Per Week
Pu	18.9
U	15.1
Mixed FP	14.8
Strontium and yttrium	3.5
Gross gamma and beta	0.3
Lead (urine, blood and experimental)	2.9
Gross gamma	2.5
K-25	0.7
Average number of samples per week	58.7
Deviation of the weekly average this quarter from 1953 weekly average	-18.0%
Total samples handled to date this year	3386
Deviation of weekly average to date this year from 1953 weekly average	+24.0%

2. Environrons

a. Air Activity Studies

Type Sample	No. of Samples Per Wk/Station	No. Stations	Total Samples For Quarter
Water	1	4	52
Filter	1	4	52
Gum paper	7	4	364
	Total 9		Total 468

3. Calibration Unit

a. Film Routine

Average number of films calibrated per week	286
Deviation of the weekly average this quarter from 1953 weekly average	-47%
Total films calibrated	3724
Deviation of 1954 weekly average from 1953 weekly average	-42%

b. Instrument Routine

Average number of instruments calibrated per week	110
Deviation of the weekly average this quarter from 1953 weekly average	-9%
Total instruments calibrated	1434
Deviation of 1954 weekly average from weekly average of 1953	-7.4%

4. Portable Instruments Repaired

a. Average number of instruments repaired per week	53
b. Deviation of the weekly average this quarter from weekly average of 1953	+29%
c. Total instruments repaired during 1954	1838
d. Deviation of 1954 weekly average to date this year from weekly average of 1953	+15%

5. Operation of Fixed and Semi-Portable Instruments*

		1	2	3	4	5	6
a.	Constant Air Monitors	4100	3033	1067	163	26%	4.0%
b.	Monitrons	4887	3878	1009	177	21%	3.6%
c.	Hand and Foot Counters	689	465	224	16	33%	2.3%
d.	AC Poppies (Alpha and Beta-Gamma)	1457	842	615	50	42%	3.4%
e.	Scalers (including alpha counters)	1762	1208	554	50	31%	2.8%
f.	Precipitrons	866	639	227	1	26%	0.12%
g.	Friskers	674	482	192	111	28%	16.4%
h.	Filtrons	640	281	359	0	56%	0%
i.	Disc Air Samplers	930	613	317	84	34%	9%

* Explanation for Column Headings:

1. Total number of "Instrument Days" where an "Instrument Day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operational reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Percent of "Instrument Days" not reported.
6. Percent of "Instrument Days" instrument reported out of service.

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

Six cases of apparent significant exposures were identified as diagnostic X-rays.

During a period of three months, the AEC fellowship students received on-the-job training in Personnel Monitoring procedures.

IBM data on individual exposures were completed for the first half of 1954.

A spot check on neutron films worn by persons who do not regularly work with neutron sources is now in process for the third period.

A major organization change occurred. The work requirements on the 4 to 12 shift, Monday through Friday, were minimized. With this change, direct supervision for the X, Y, Z shifts became the responsibility of the ABCD shift supervisors.

Personnel exposures did not differ significantly from previous periods. Fig. 4 is a breakdown by Laboratory divisions showing the number of significant exposures and the number of cases where the weekly MPE or quarterly MPE is exceeded.

Fig. 5 is a breakdown by Laboratory divisions showing the number of overage weeks and the number of persons involved.

Fig. 6 is a plot showing the exposure total of the ten employees who sustained the highest exposure during the quarter. Three persons slightly exceeded the MPE for the period with the result that work assignments were changed.

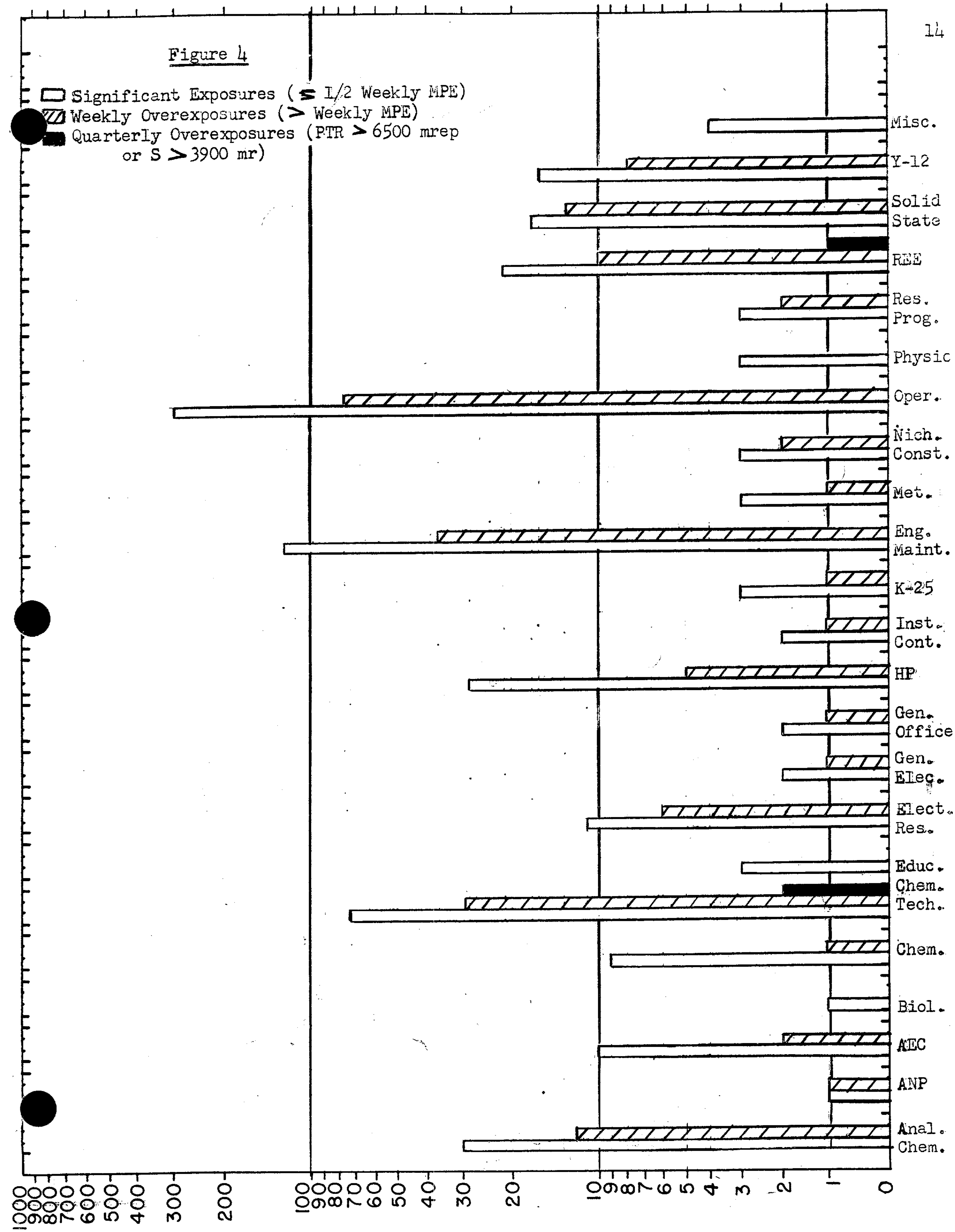

Significant Exposures (≤ 1/2 Weekly MPE)
Weekly Overexposures (> Weekly MPE)
Quarterly Overexposures (PTR > 6500 mrep
or S > 3900 mr)
Misc.
Y-12
Solid State
REE
Res. Prog.
Physic
Oper.
Nich. Const.
Met.
Eng. Maint.
K-25
Inst. Cont.
HP
Gen. Office
Gen. Elec.
Elect. Res.
Educ.
Chem. Tech.
Chem.
Biol.
AEC
ANP
Anal. Chem.
1000 900 800 700 600 500 400 300 200 100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1 0

Figure 4

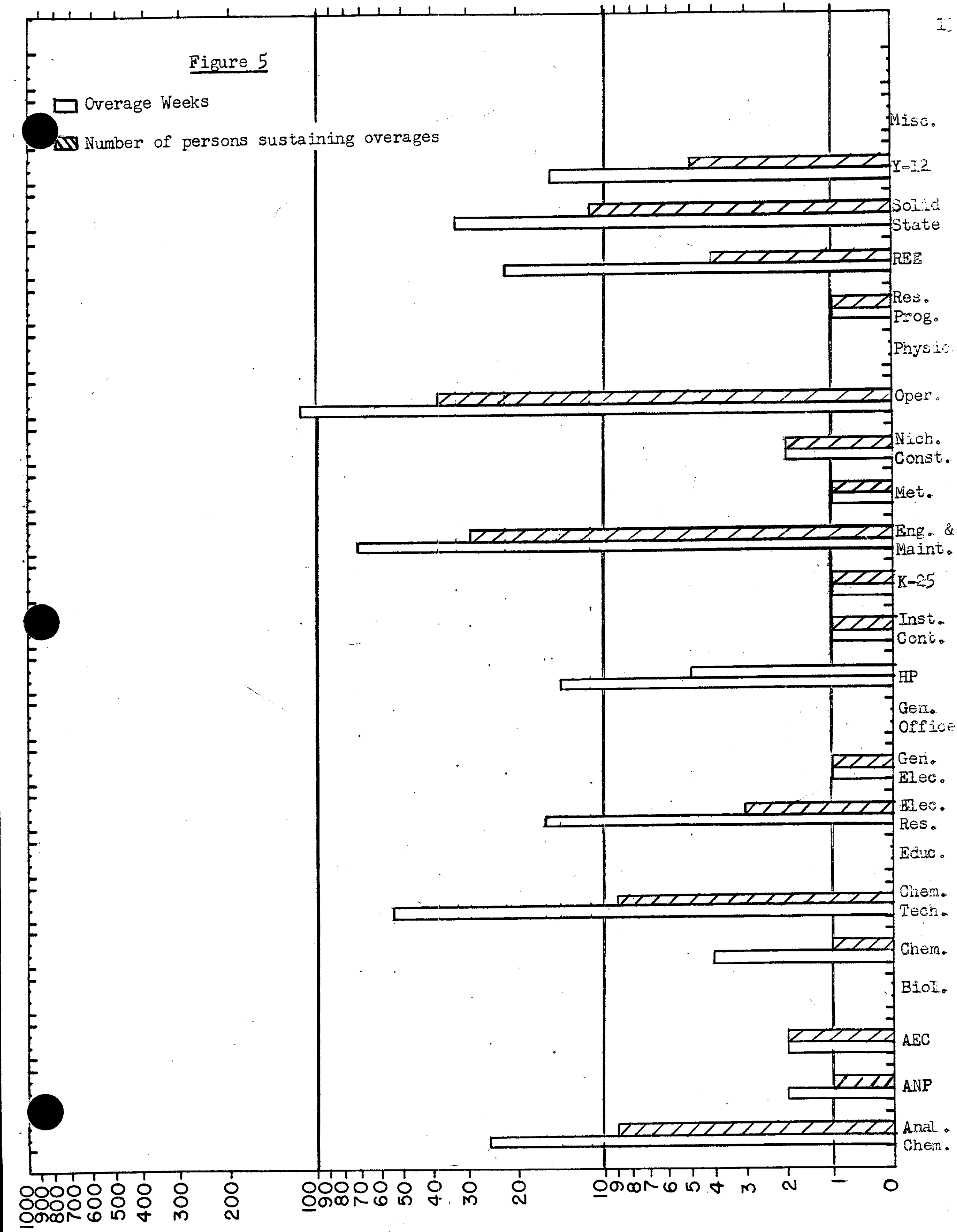
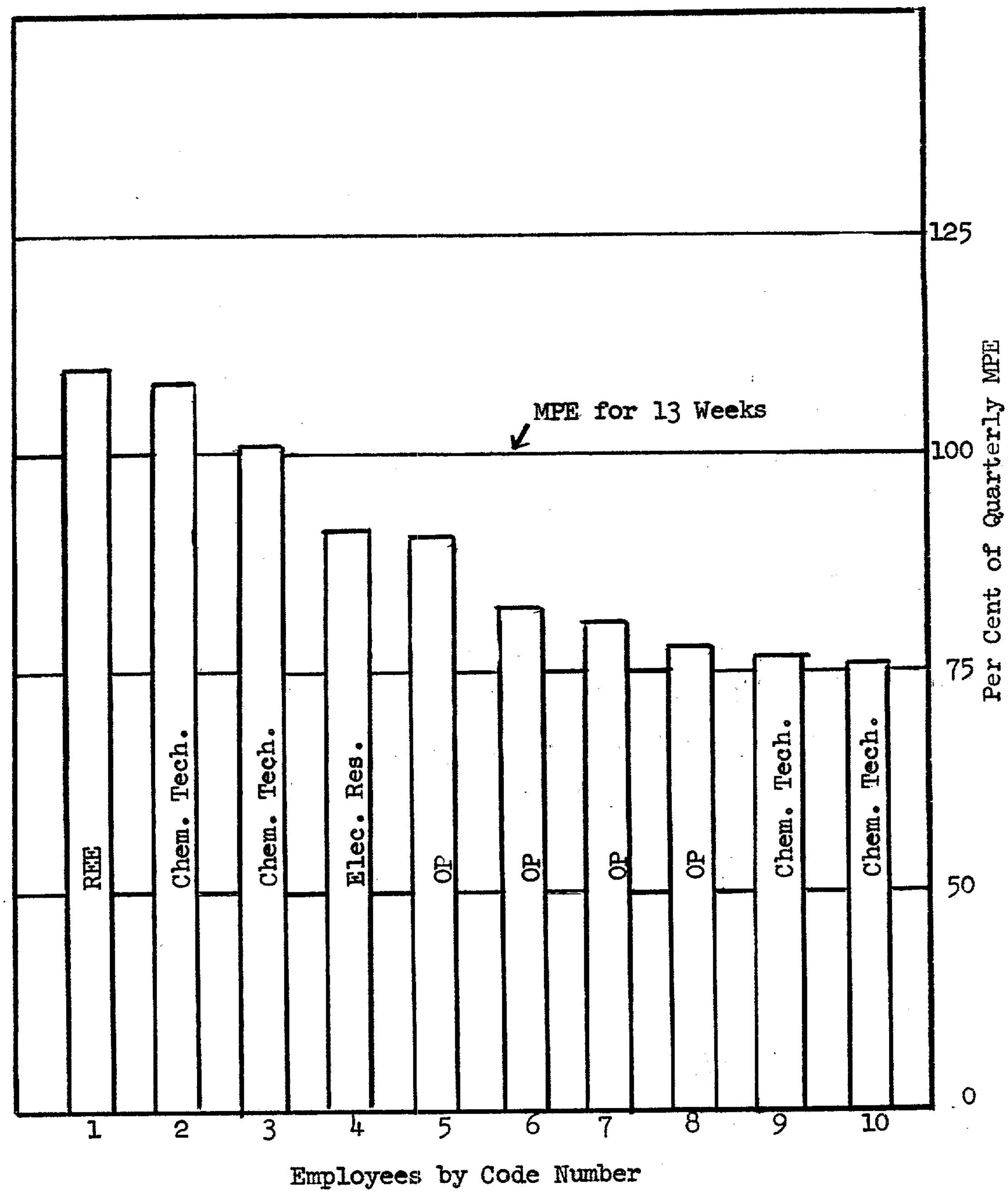

Overage Weeks
Number of persons sustaining overages
Misc.
Y-12
Solid State
REE
Res. Prog.
Physics
Oper.
Mich. Const.
Met.
Eng. & Maint.
K-25
Inst. Cont.
HP
Gen. Office
Gen. Elec.
Elec. Res.
Educ.
Chem. Tech.
Chem.
Biol.
AEC
ANP
Anal. Chem.
1000 900 800 700 600 500 400 300 200 100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1 0

Figure 5

Figure 6


MPE for 13 Weeks
125
100
75
50
0
Per Cent of Quarterly MPE
REE
Chem. Tech.
Chem. Tech.
Elec. Res.
OP
OP
OP
OP
Chem. Tech.
Chem. Tech.
1
2
3
4
5
6
7
8
9
10
Employees by Code Number

Part B. Statistical Data

1. Personnel Meters

a. Distribution and Performance of Pocket Meters

	Weekly Ave. to Date This Year	Deviation of This Year's Ave. from 1953 Weekly Average
Meters distributed	4670	-60.6%
Readable Meters	4667	-60.6%
Non-readable meters	4.03	-59.7%
Non-readable pairs	0.10	+400.0
Off-scale readings	17	-58.5%
Off-scale pairs	1.72	-27.7%

b. Distribution and Processing Data of Film Meters

West Portal	1741	-12.1%
East Portal	1038	+13.6%
Visitors	452	+28.4%
Ring films, packets, etc.	47	-64.7%
Routine neutron films	205	-6.8%
Special neutron films	140	+600.0%
Calibrations	178	-13.2%
Correspondents	539	-74.3%
Special X-ray films	22	-26.7%
Total films handled	4378	-26.4%

c. Film Meter Data Loss

Badge meters not serviced	45	+78.6%
Films lost	0	-100.0%
Films damaged	0	-100.0%
Total	45	+77.2%

2. Investigations Initiated

a. From Pocket Meter Records

Significant total of 300 mr(ep) or more	0.13	-89.1%
Off-scale pairs	1.74	-27.5%
Non-readable pairs	0.03	+50.0%
Total	1.90	-47.4%

b. From Film Meter Records	Weekly Ave. to Date This Year
Weekly PTR of 1000 mrep or more, or shield of 600 mr or more	3.03
Questionable PTR of 1000 mrep or more	0.69
Lost or damaged films	0.03
Average 100% of MPE/wk	2.97
Total	6.72

c. Investigation Results	Investigated to Date This Year	Confirmed to Date This Year
Pocket Meters	71	33
Film Meters	293	235
Total	364	268

Paired off-scale pocket meters investigated to date this year 61

Legitimate number of off-scale pocket meter pairs to date 30

Statistical probability of spurious (paired off-scale) pocket meter readings to date this year 1.18

d. Laundry Decontamination Measurements	Weekly Ave. to Date This Year	Dev. of This Year's Weekly Ave. from 1953 Weekly Average
Garments	3790	-00.5%
Pairs of shoes for replacement	6	-66.7%
Special Items	1167	+23.6%
Total	4659	-02.3%

SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

The following activity hazard incident reports and memoranda describe the radiation hazard incidents which occurred during the quarter ending September 30, 1954.

1. RS-120-54, No. 208, describes an incident of contamination which occurred on the Melton Valley Road on July 6, 1954.

2. RS-122-54, No. 209, discusses a contamination incident in Building 3025 on August 18, 1954. The source of contamination involved work with Hanford irradiated slugs.

3. "Spread of Alpha Contamination in Building 4500 and 4501," dated August 30, 1954. The incident occurred on August 30, 1954.

4. "Spill in Hot Storage Area South of Building 3550," dated September 22, 1954. The spill occurred on September 2, 1954.

5. A memo from R. L. Clark to J. C. Hart and A. D. Warden, dated September 13, 1954, describes an incident which occurred on September 10, 1954, in Building 2001. The incident involved the accidental release of approximately 40 mc of polonium into a vacuum system connected to an experimental set-up.

6. RS-124-54, No. 211, discusses a contamination incident which occurred on September 18, 1954, in Building 3019. Room 208, the halls, and a cabinet were contaminated when a radioactive sample was dropped and broken.

7. "Fused Salt Explosion in Room A-25, Building 4500, September 20, 1954," dated September 22, 1954.

Due to excessive radiation and airborne contamination, operations in the Semi-works in Building 3550 have been discontinued pending a thorough study and redesign of the facilities.

On July 2, 1954, a leaking radium source was returned to the New York Operations office for repair and subsequent recalibration by the National Bureau of Standards. The source contained 500 mg of radium.

SECTION V. TECHNOLOGICAL STUDIES

During this quarter the effort of the Section was distributed as follows:

1. Problems of Environs Group (reported under "Assays - Instruments") 46%

2. Special and Technical Problems 54%

The latter effort was principally devoted to the study of:

1. Various hazards as associated with present and proposed reactors 68%

2. Other technical problems of Health Physics including: 32%

   a. Buildup of area background at ORNL

   b. Skin dose rates for Ca^{45}

   c. ORR beam hole flux values

   d. Other problems

The hazard studies on reactors was prepared primarily for the Reactor Safeguards Committee as related to the ORR and the HRT. A study was made also of the hazards apparently associated with the proposed University of Michigan Reactor.

J. C. Hart

J. C. Hart, Chief
Applied Health Physics

Data Compiled by: A. D. Warden
D. M. Davis
J. C. Ledbetter
T. J. Burnett
H. H. Abee
et al

JCH/pr

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ORNL
CENTRAL FILES NUMBER
55-1-203

Oak Ridge National Laboratory Health Physics Division

Cy-36

APPLIED HEALTH PHYSICS QUARTERLY REPORT (U)

4th Quarter 1954
October
November
December

DECLASSIFIED Per Letter Instructions Of
D. Murphy 2-14-58
D. McGhee
For: N. T. Bray, Supervisor
Laboratory Records Dept.
ORNL

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This document has been approved for release to the public by:

David R Hamrin 5/21/96
Technical Information Officer Date
ORNL Site

SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

Air activity based on an average of ten continuous air monitors showed an increase over that of last quarter. The weekly average value for the quarter was 10.7×10^{-13} μc/cc which is 37% greater than that recorded for the 3rd quarter. The highest average value for a single week occurred during the week ending November 8th with a value of 26.0×10^{-13} μc/cc. The highest average activity recorded on a single air monitor was 95.1×10^{-13} μc/cc recorded during the same week. The high averages for the year shown on two air monitors are attributed to a chemical spill in Building 3026-D which occurred earlier in the year.

The average radio-particulate count showed an increase proportionate to that of the air activity. The average weekly particulate count for ten continuous air monitors for the quarter was 0.95 particles per 1000 ft^3 of air sampled. This is 35.7% greater than the average for last quarter, but is 55.6% less than that experienced during the year 1953. The highest average particulate count for a single week was 3.80 particles per 1000 ft^3, and occurred during the week ending November 8. The highest average count for a single air monitor occurred during the same week with a value of 9.92 particles per 1000 ft^3. Fig. 1, p. 2, is a plot showing the particle count for 1954.

The weekly average radio-particulate count for the year has been tabulated in section 2-b, p. 8. Particle intensity was determined by a method which compares the autoradiogram images with the image of a particle, the intensity of which is known. Approximately 95% of the particles collected show activity below 10^5 disintegrations per 24 hours, which appears to be significantly low when considered as a health hazard.

Activity in the discharge from White Oak Lake increased by 38.1% over the relatively low values recorded during the last quarter. The operating MPC of 10^{-7} μc/cc was exceeded 46% of the time during the quarter as illustrated in Fig. 2, p. 3. The calculated probable weekly average concentration in the Clinch River for the quarter was 1.47×10^{-7} μc/cc which is 81.5% greater than that for last quarter, and 30.1% greater than the average for last year. In all, the weekly average discharge for 1954 was greater than the 1953 values by 83.5%.

As a result of improvements in Monitoring techniques, and since the value of 10^{-7} μc/cc is established for an unknown mixture of radioisotopes, a more direct approach to the problem of determining the concentration of activity from White Oak Lake discharge was studied. A monthly composite sample of the effluent was radiochemically analyzed and the maximum permissible concentration calculated for each radio element found by this analysis. The results on this one study indicated that the current operating MPC of 10^{-7} μc/cc gross β in the Clinch River

Figure 1

AIR PARTICULATE ACTIVITY
Average of 10 CAM's

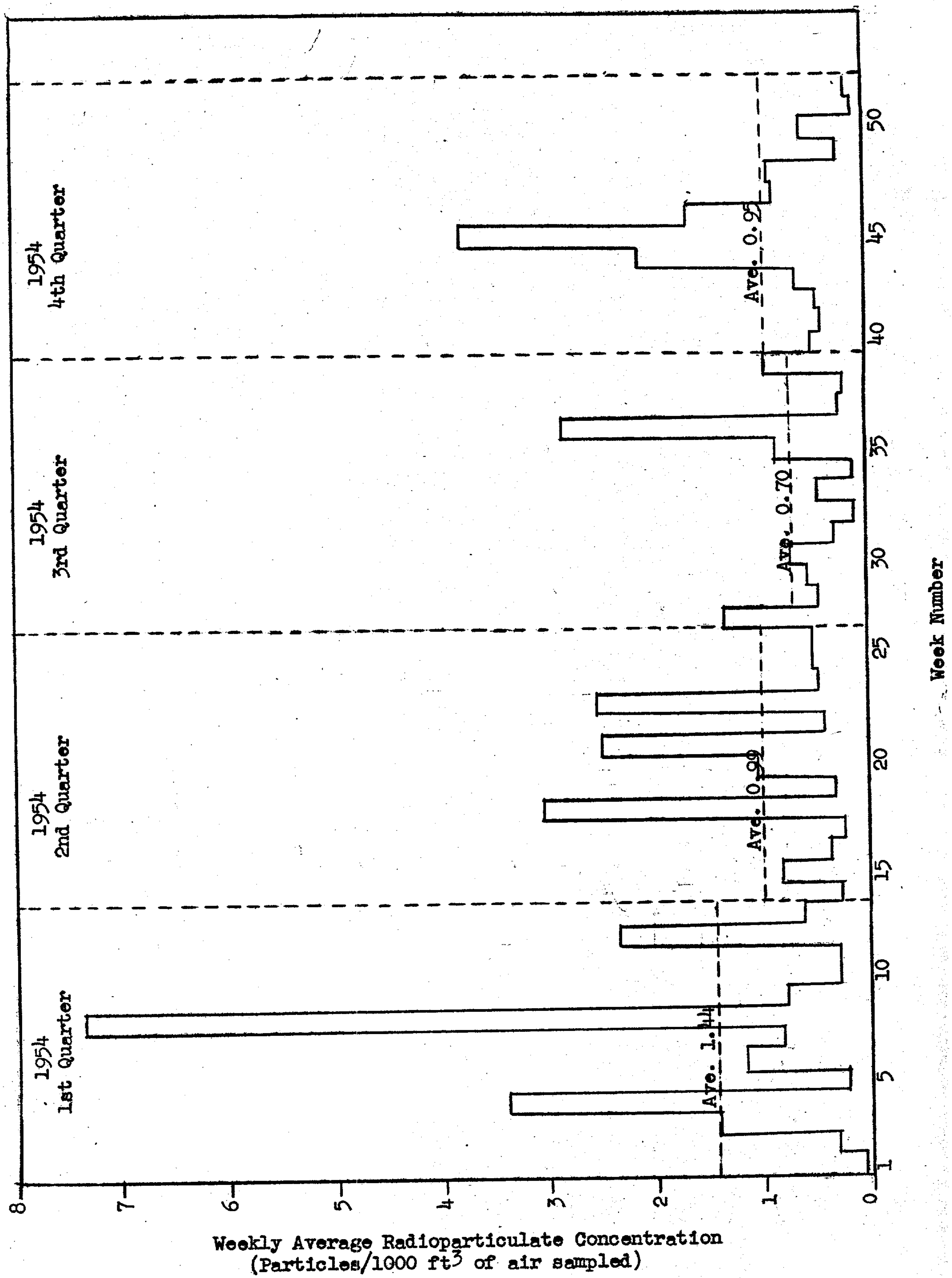
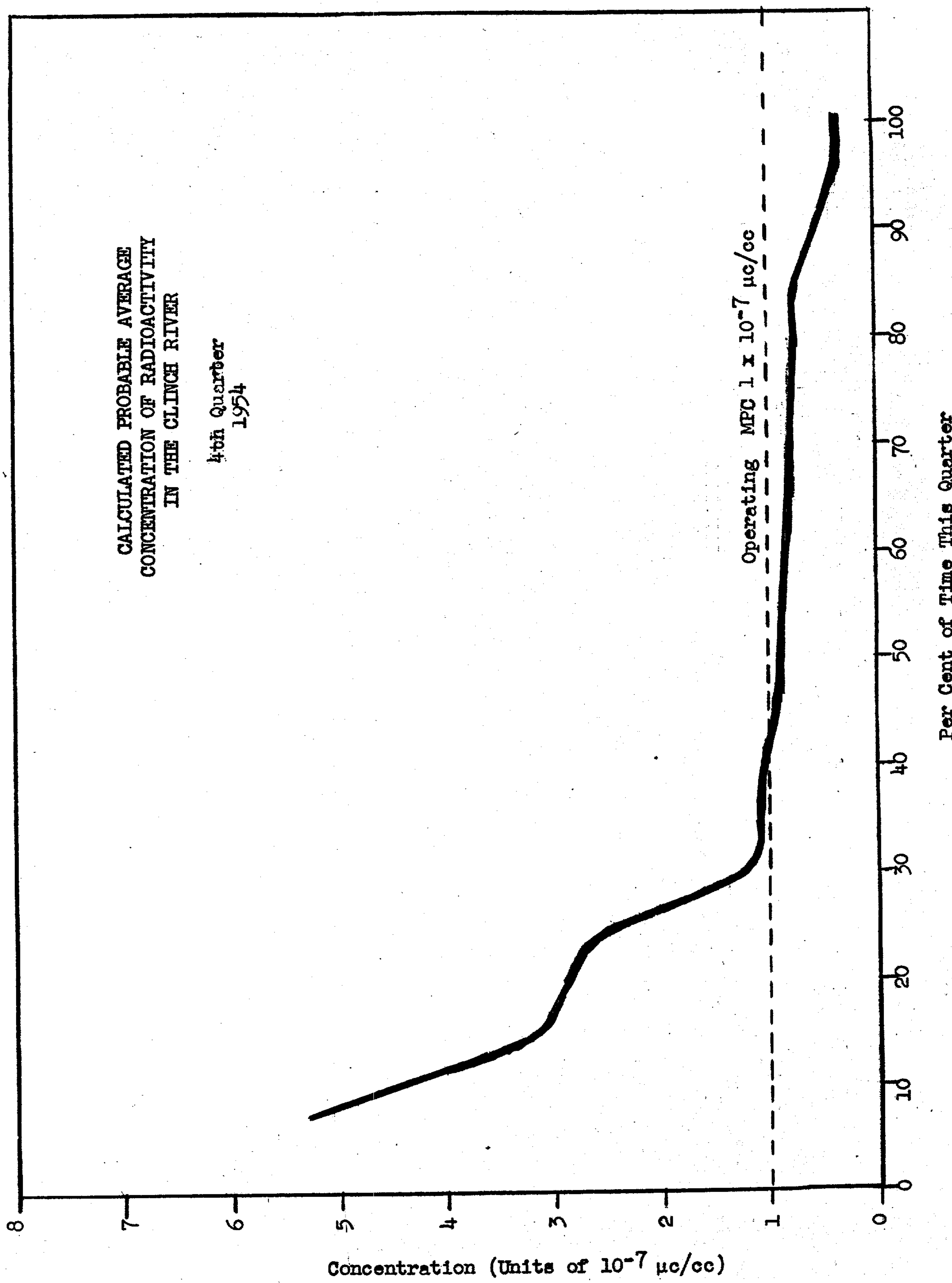


Figure 2


CALCULATED PROBABLE AVERAGE
CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER
4th Quarter
1954
Operating MPC 1 x 10^{-7} μc/cc
0
10
20
30
40
50
60
70
80
90
100
Per Cent of Time This Quarter
8
7
6
5
4
3
2
1
0
Concentration (Units of 10^{-7} μc/cc)

is a reasonably safe value as long as the chemical composition of White Oak Lake effluent continues as at present. Fig. 3, p. 5, is a plot showing results obtained by the two methods.

A total of 27,694 garments were checked for contamination prior to being sent to commercial laundries for cleaning. Of this total, 3.2% were held out as exceeding the MPL for a commercial laundry. Fig. 4, p. 6 is a plot of the weekly fluxuations in the operation and indicates that the percent contaminated for the quarter dropped considerably below last quarter's value of 5.1%.

Area background measurements were taken monthly and reported separately. The average monthly background for the Laboratory site for the quarter was 24% less than the third quarter and 7% less than the average for last year.

The annual mud survey of White Oak Lake was performed during the month of October. All the samples were taken in a single day with the help of two men borrowed from the Assay-Instruments Section. A total of 162 samples were brought into the laboratory for gross analysis. Processing of the samples has been under way for the remainder of the quarter and will continue into next quarter.

Data from the ten continuous air monitors are now being telemetered to Monitoring headquarters. This will make it possible to evaluate the air activity over the plant almost instantaneously and thus in case of a plant emergency involving air activity to decide on a course of action.

Figure 3

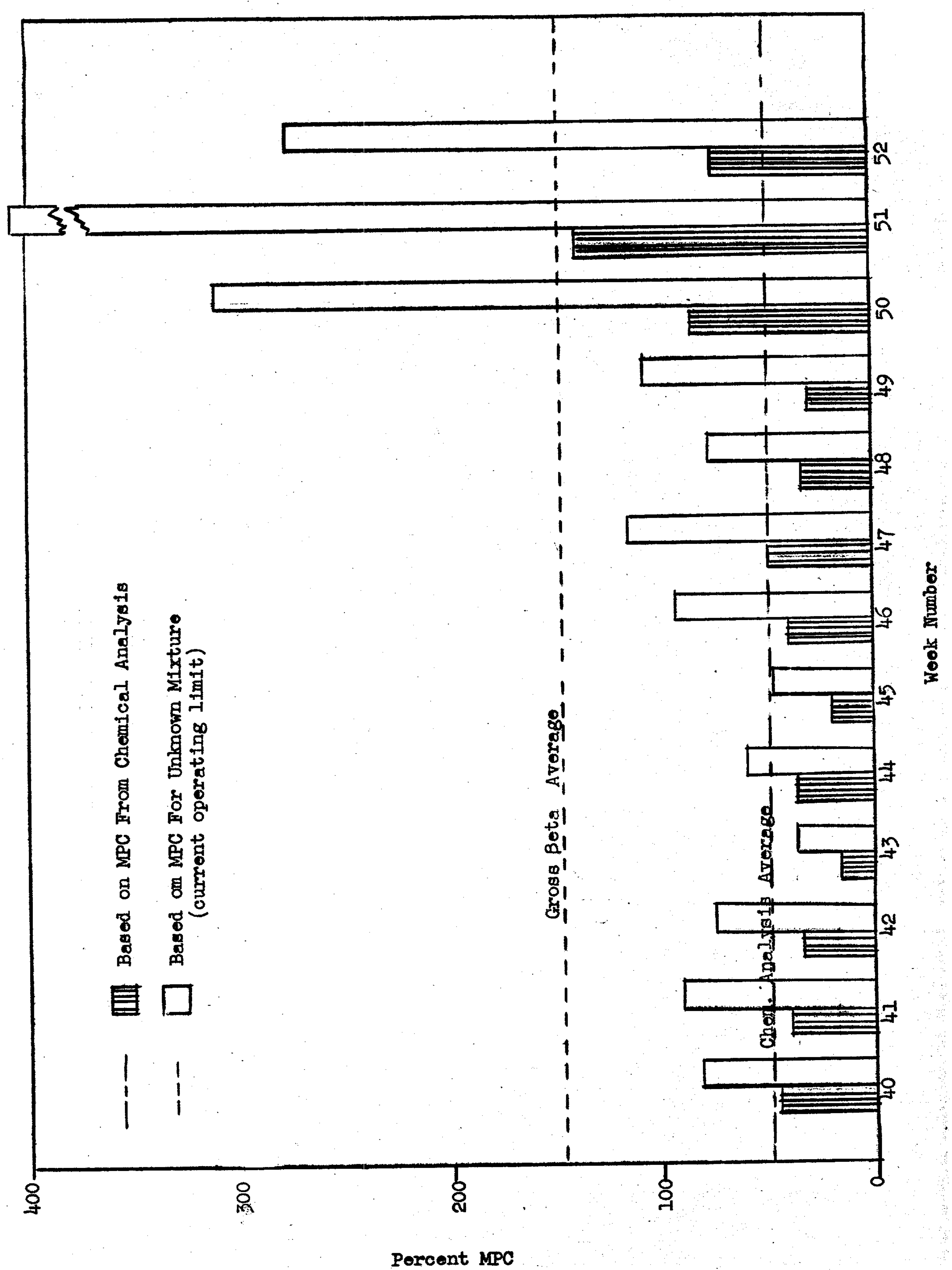
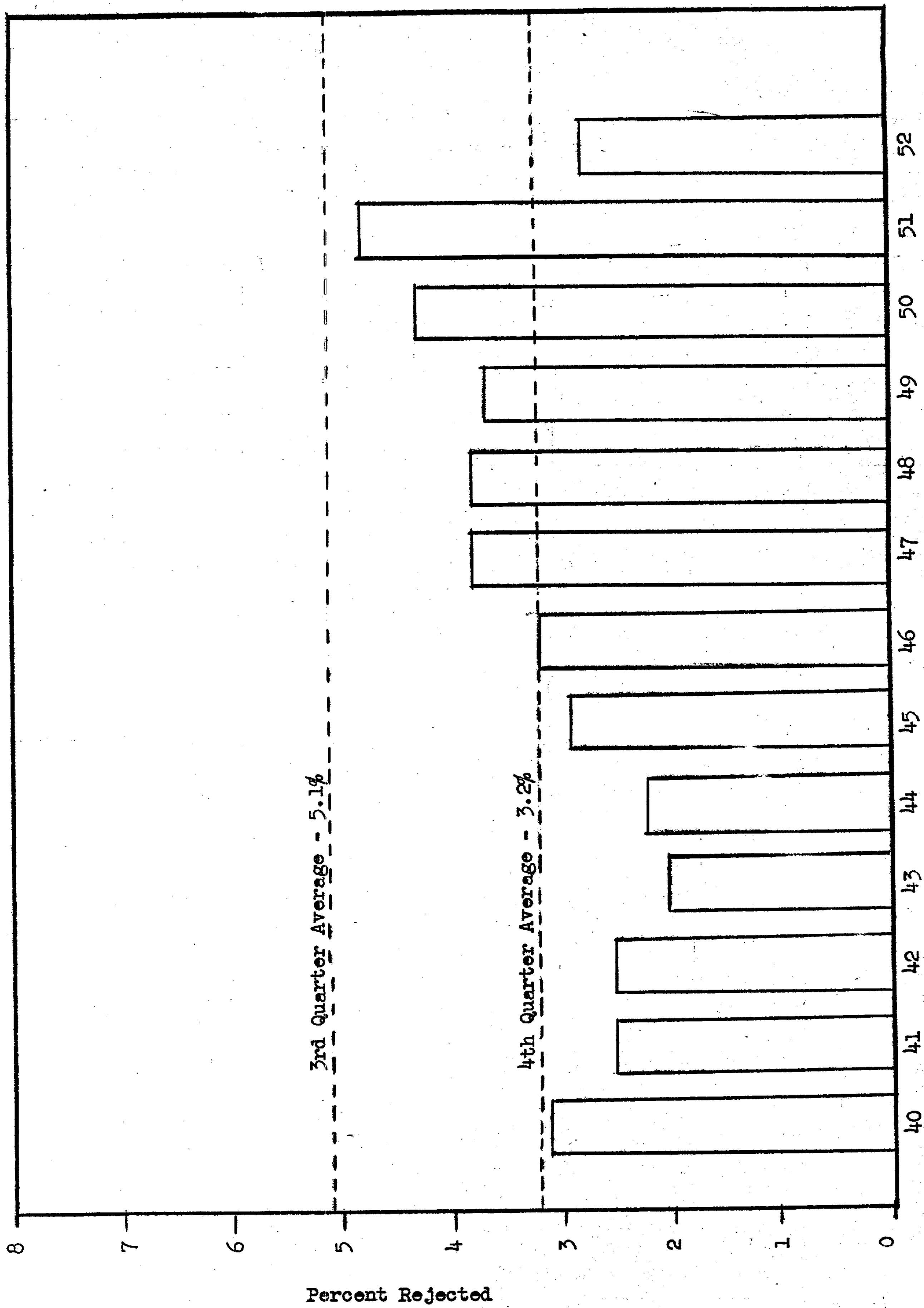

Based on MPC From Chemical Analysis
Based om MPC For Unknown Mixture
(current operating limit)
Gross Beta Average
Chem. Analysis Average
400
300
200
100
0
Percent MPC
40
41
42
43
44
45
46
47
48
49
50
51
52
Week Number

Figure 4

CONTAMINATION REJECTS OF GARMENTS
SUBJECT TO COMMERCIAL LAUNDERING



Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

Station Number	Location	Average Long Lived Activity: Wkly. Av. to Date This Year, Conc. x 10^{-13} μc/cc	Deviation From 1953 Weekly Average
HP-1	N 3550	34.29	- 1.2%
HP-2	S 3001	3938.06	+14,116.8%
HP-3	S 1000	12.59	-44.1%
HP-4	W 3513	6.34	-47.1%
HP-5	E 2506	69.37	-76.1%
HP-6	SE 3012	688.87	+5659.8%
HP-7	W 7001	8.02	-17.6%
HP-8	Rock Quarry	4.11	-65.0%
HP-9	A-10 Site	6.67	-41.1%
HP-10	S 2007	15.30	-52.2%
Average		478.36	

Deviation of this year's average long lived activity to date from last year's average +930.9%

2. Particulate Studies

a. USPHS Filter

Number	Location	Weekly Average To Date This Year Particles Per 1000 ft^3	Deviation of Wkly. Av. to Date This Year From Wkly. Av. Last Year
A-1	3026	1.29	-64.9%
A-2	3003	0.14	-80.0%
A-3	1000	0.37	-47.1%
A-4	7001	0.05	-76.7%
A-5	3550	3.18	-57.7%
Average		1.01	

Deviation of this year's weekly average to date from weekly average last year -63.6%

b. CAM Filter

Number	Location	Particle Distribution, Weekly Average No. of Particles, Activity Ranges - Dis./24 Hours: $<10^5$	10^5-10^6	10^6-10^7	$>10^7$	Total	Weekly Av. to Date This Year Particles Per 1000 cu. ft.	Deviation o[f] Wkly. Av. t[o] Date This Year From Weekly Av. Last Year
HP-1	N 3550	77.28	8.12	0.13	0.02	85.55	1.45	-31.3%
HP-2	S 3001	46.84	5.02	0.21	0.00	52.07	1.26	-34.0%
HP-3	S 1000	22.21	3.40	0.08	0.00	25.69	0.54	-73.4%
HP-4	W 3513	15.15	2.77	0.10	0.00	18.02	0.36	-83.1%
HP-5	E 2506	167.00	8.31	0.29	0.17	175.77	3.34	-30.0%
HP-6	SE 3012	28.69	3.50	0.06	0.00	32.25	0.67	-58.9%
HP-7	W 7001	19.86	2.17	0.06	0.00	22.09	0.44	-69.7%
HP-8	Rock Quarry	14.71	1.33	0.02	0.00	16.06	0.33	-82.0%
HP-9	A-10 Site	23.88	2.06	0.02	0.00	25.96	0.52	-66.0%
HP-10	S 2007	43.17	2.60	0.04	0.00	45.81	0.79	-61.5%
Average							0.97	

Deviation of this year's weekly average to date from weekly average last year: -54.7%

3. Meteorological Data

a. Rainfall

Total This year	48.83 in.
Normal yearly rainfall	52.04 in.
Deviation from normal seasonal rainfall	+9.3%

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin Beta	White Oak Lake Beta
Weekly Av. to Date this year	4.51	7.38
Deviation from 1953 weekly average	-19.2%	+26.4%

b. Submersion Data

	Settling Basin			White Oak Lake		
	β eta Mrep/hr	Gamma mr/hr	Total mr(ep)/hr	β eta Mrep/hr	Gamma mr/hr	Total mr(ep)/hr
Weekly Av. to Date This Year	0.494	0.527	1.021	0.036	0.029	0.065
Deviation from 1953 weekly Average	+40.3%	+19.2%	+28.6%	+ 9.1%	+16.0%	+12.1%

c. Plutonium Discharged

	Settling Basin		White Oak Lake	
	Conc. x 10-9 μg/cc	Total mg Plutonium	Conc. x 10-9 μg/cc	Total mg Plutonium
Weekly Av. to Date This Year	3054.3	29.900	98.5	22.707
Deviation from 1953 Weekly Average	+23.7%	-22.5%	-26.9%	-13.0%

d. Probable Average Concentration in Clinch River Below White Oak Creek using as a dilution factor the ratio of White Oak Lake discharge to the flow of Clinch River.

Weekly Average to Date This Year	1.67×10^{-7} μc/cc
Deviation from 1953 Weekly Average	+83.5%

SECTION II. ASSAYS - INSTRUMENTS

Part A. Salient and Non-Routine Items

The urinalysis procedure for Sr has been revised according to techniques and methods developed by L. B. Farabee. The new procedure will permit a technician to process up to 50% more samples per unit time with an increase in reliability.

A scintillation type alpha detector, GE Probe Type, was received and tested. Favorable results were obtained in tests with an AC Power Supply and a Portable Power Supply. An order has been placed for a few of these instruments.

All known sources in the ORNL area which contain 0.1 mg or more of Ra salt have been "canned". This program also included many polonium and other type sources.

Routine checking and adjustment of Projection Minometers has been assumed by the Personnel Monitoring Section. Repairs and major adjustments remain the responsibility of the Applied Health Physics Instruments Group.

A total of 14 core holes were monitored this quarter. Six of these showed peaks of activity greater than 4 times background for the respective hole. The maximum activity detected, observed in hole No. 1 drilled underneath the settling basin, was approximately 24 times background.

A. E. Carter and F. A. Markli have been assigned "on loan" to the Research Instrument Development Group.

E. D. Gupton attended the Radiological Society of North America Conference in Los Angeles and presented a paper entitled, "Calibration and Dosage Determination in βeta-Gamma X-ray Film Dosimetry at ORNL".

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Per Week Alpha	No. Counts Performed Per Week Beta	Units Per Count*	Average Total Units/Wk for 1954
Smears		2259	2363	1	4622
Air Samples	209	246	234	3	1767
Applied Radiobiology			33.4	4	133.6
Ecological Studies			41.1	4	164.3
Area Monitoring		8.3	31.3	4	157.2
Environmental Studies			114.2	4	456.8
Applied Radio Biology (Mice)			13.8	4	55.4
Decay and Absorption Studies	59.9		126.3	4	744.8

Average Units per Week This Quarter	8101
Deviation of weekly average this quarter from 1953 weekly average	-32.5%
Total units handled to date this year	451213
Deviation of weekly average to date this year from 1953 weekly average	-27.6%

*Unit = 2/3 Min.

b. Chemical Analysis

	Weekly Average
Pu	19.6
U	19.2
FP	12.4
Sr	8.2
Gamma	0.31
Gross Alpha	3.08
Po	0.08
Pa	0.08
Lead (Urine)	3.08
(Blood)	1.23
K-25 Pu	2.08
Pb	0.08

Average No. of Samples per week	69.5
Deviation of weekly average this quarter from 1953 weekly average	-0.7%
Total samples handled to date this year	4288
Deviation of weekly average to date this year from 1953 weekly average	+18.14%

2. Environs

a. Air Activity Studies

Type Sample	No. of Samples Per Wk/Station	No. Stations	Total Samples For Quarter
Water	1	4	56
Filter	1	4	56
Gum Paper	7	4	294
Total	9	Total	406

3. Calibration Unit

a. Film Routine

Average number of films calibrated per week — 210

Deviation of the weekly average this quarter from 1953 weekly average — -61%

Total films calibrated — 2736

Deviation of 1954 weekly average from 1953 weekly average — -46%

b. Instrument Routine

Average number of instruments calibrated per week — 89

Deviation of the weekly average this quarter from 1953 weekly average — -26%

Total instruments calibrated — 1156

Deviation of 1954 weekly average from weekly average of 1953 — -12%

4. Portable Instruments Repaired

a. Average number of instruments repaired per week — 47

b. Deviation of the weekly average this quarter for weekly average of 1953 — +15%

c. Total instruments repaired during 1954 — 2452

d. Deviation of 1954 weekly average to date this year from weekly average of 1953 — +15%

5. Operation of Fixed and Semi-Portable Instruments*

		1	2	3	4	5	6
a.	Constant Air Monitors	4160	2692	1468	156	35%	3.8%
b.	Monitrons	4992	3386	1606	135	32%	2.7%
c.	Hand & Foot Counters	704	368	336	10	48%	1.4%
d.	AC Poppies (Alpha and βeta-Gamma)	1472	602	870	14	59%	1.0%
e.	Scalers (including alpha counters)	1792	1077	715	9	40%	.5%
f.	Precipitrons	896	536	360	0	40%	0%
g.	Friskers	704	482	222	67	32%	9.5%
h.	Filtrons	640	266	374	0	58%	0%
i.	Disc Air Samplers	960	458	502	100	52%	10.4%

*Explanation for Column Headings:

1. Total number of "Instrument Days" where an "Instrument Day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operational reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Percent of "Instrument Days" not reported.
6. Percent of "Instrument Days" instrument reported out of service.

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

Five cases of significant exposures were identified as due to diagnostic X-ray. This appears to be average for the year. In practically all cases the exposures were traced to dental examinations. In general, personnel exposures were lower for the quarter than in previous periods, and in no case was the 13 weeks MPE exceeded.

Fig. 5, p. 15, is a breakdown by Laboratory Divisions showing the number of significant exposures and the number of cases where the weekly MPE is exceeded.

Fig. 6, p. 16, is a breakdown by Laboratory Divisions showing the number of overage weeks and the number of persons involved. Here again there are no significant trends since the results for the quarter are typical of previous experience.

Fig. 7, p. 17, is a plot showing the exposure total of the ten employees sustaining the highest exposure for the quarter. In no case was the 13 weeks MPE exceeded.

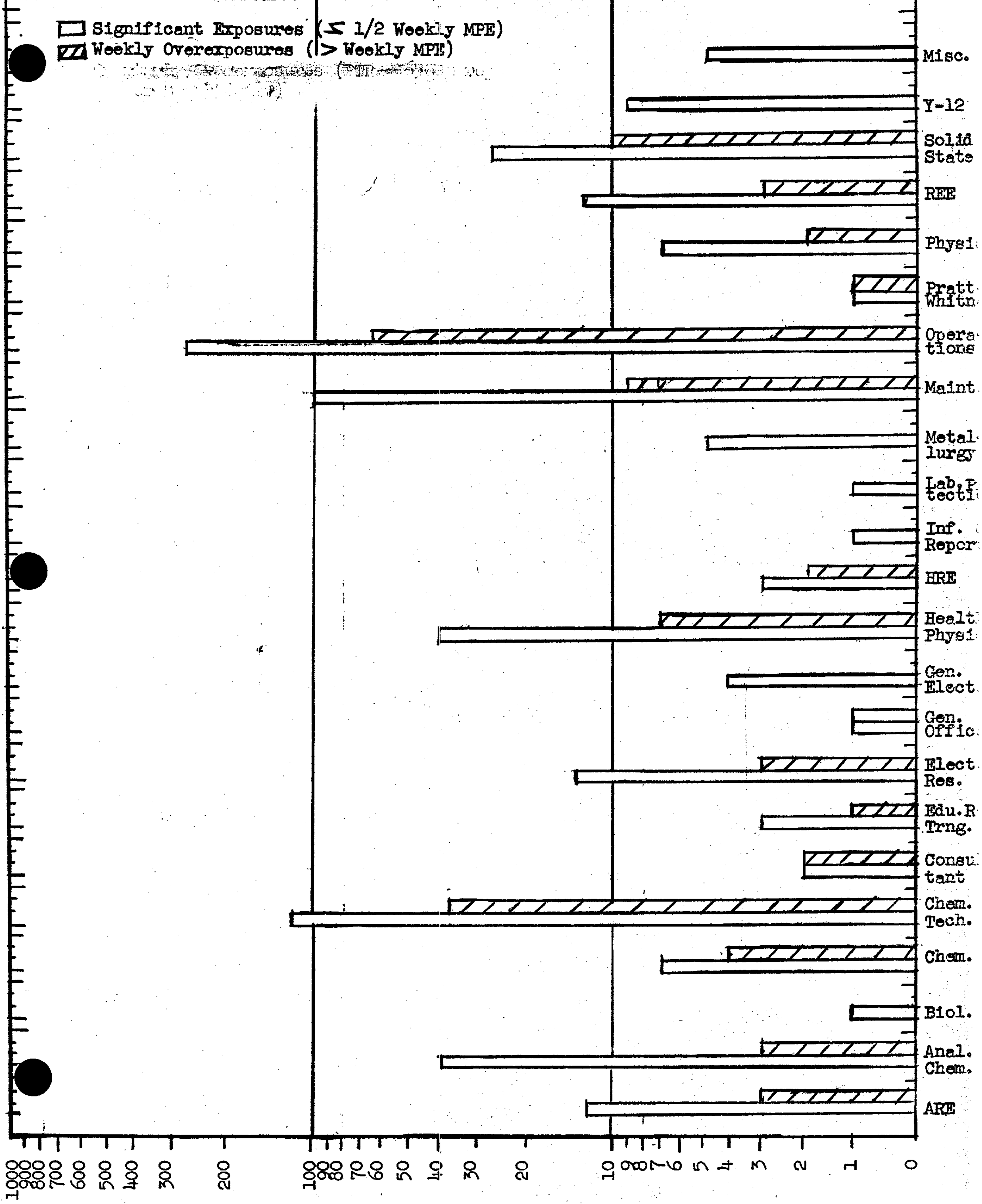
Part B. Statistical Data

1. Personnel Meters

a. Distribution and Performance of Pocket Meters

	Weekly Av. to Date This Year.	Deviation of This Year's Ave. from 1954 Weekly Average
Meters distributed	4618	-61.0%
Readable meters	4616	-61.0%
Non-readable meters	4	-60.0%
Non-readable pairs	.07	250.0%
Off-scale readings	16	-61.0%
Off-scale pairs	1.65	-31.5%

Figure 5


Significant Exposures (≤ 1/2 Weekly MPE)
Weekly Overexposures (> Weekly MPE)
Misc.
Y-12
Solid State
REE
Physi
Pratt Whitn
Operations
Maint
Metallurgy
Lab. P tecti
Inf. Repor
HRE
Healt Physi
Gen. Elect
Gen. Offic
Elect Res.
Edu. R Trng.
Consultant
Chem. Tech.
Chem.
Biol.
Anal. Chem.
ARE
1000 900 800 700 600 500 400 300 200 100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1 0

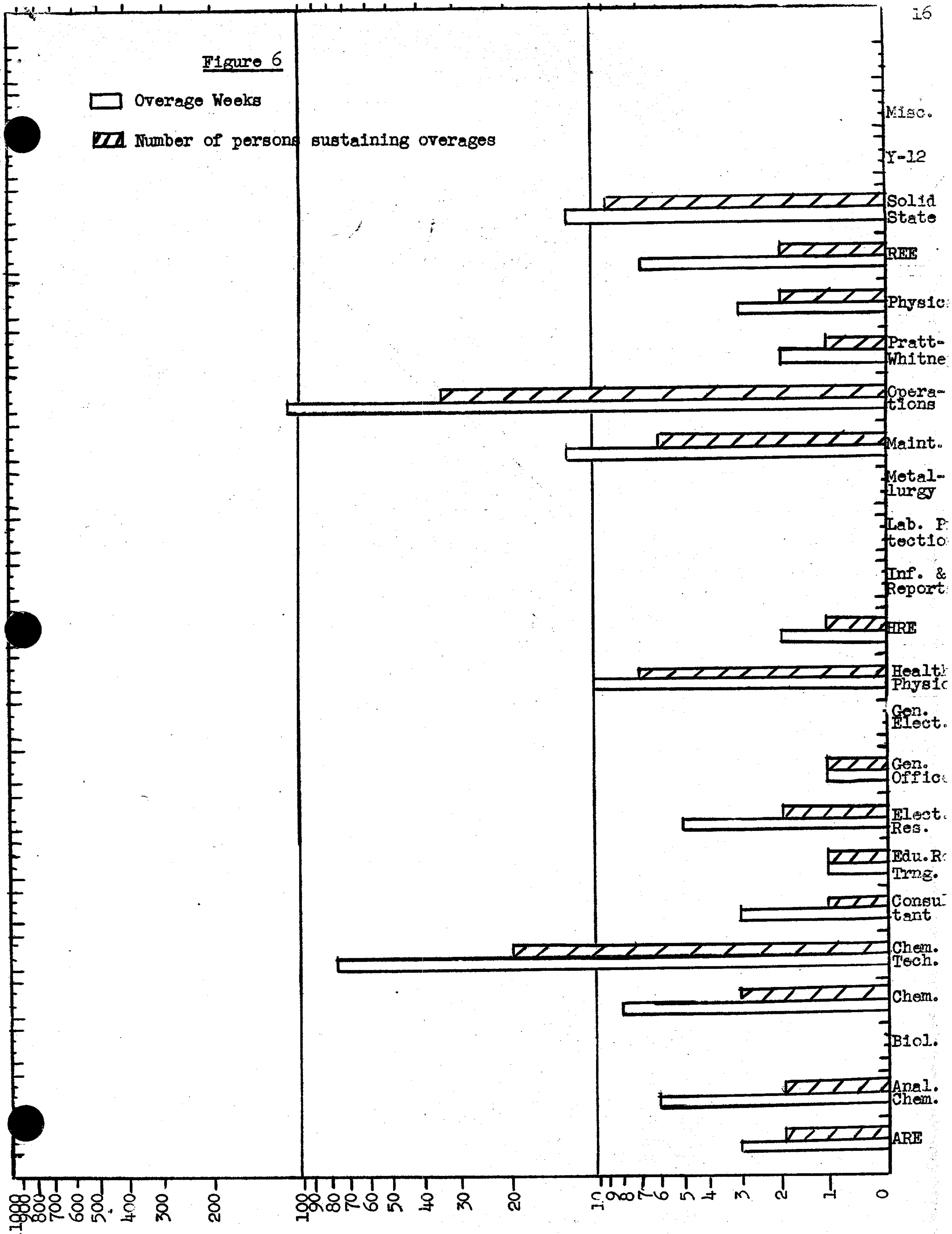
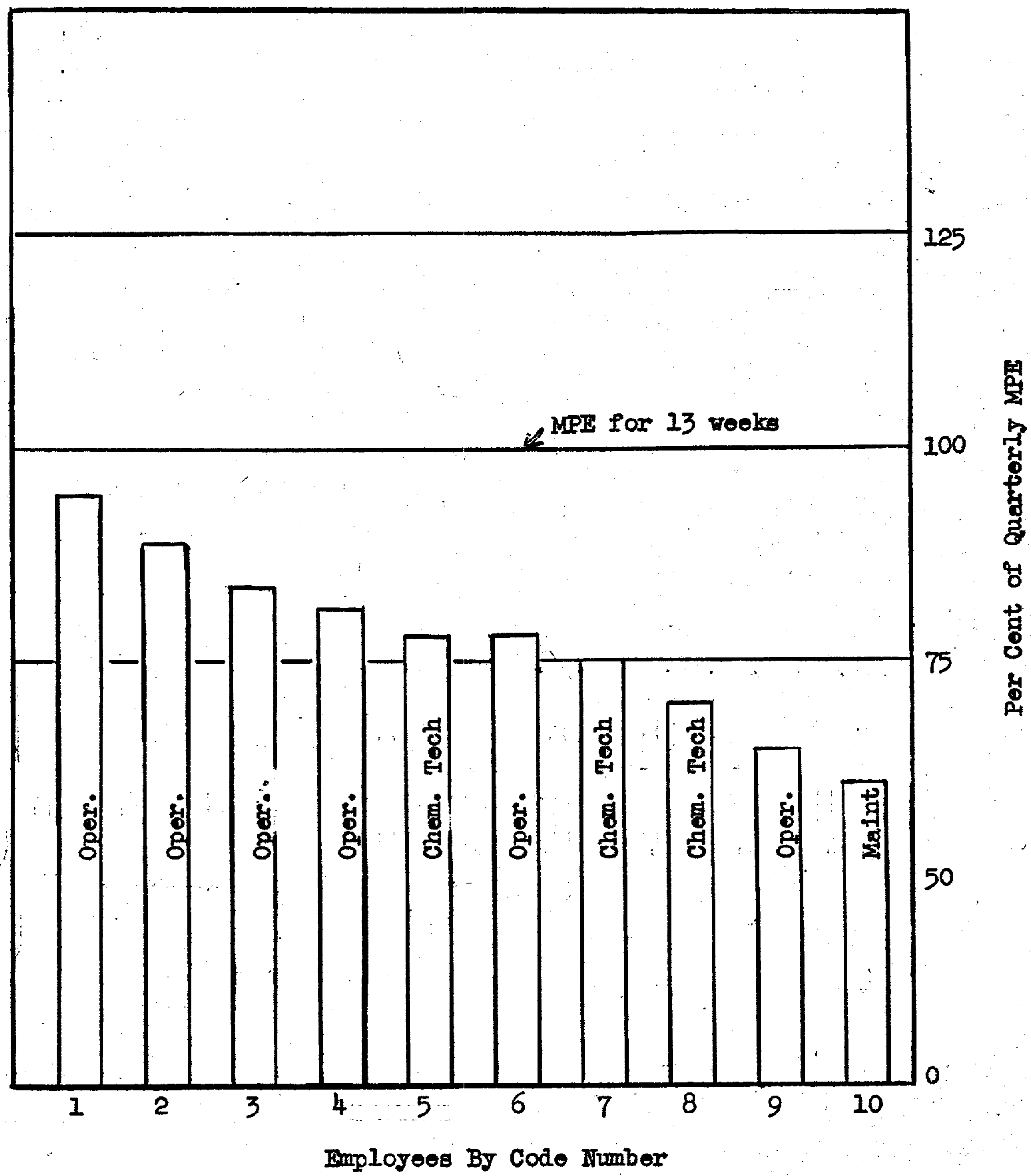


Figure 6
Overage Weeks
Number of persons sustaining overages
Misc.
Y-12
Solid State
REE
Physic
Pratt-Whitne
Opera-tions
Maint.
Metal-lurgy
Lab. P tectio
Inf. & Report
HRE
Healt Physic
Gen. Elect.
Gen. Offic
Elect. Res.
Edu.R Trng.
Consu tant
Chem. Tech.
Chem.
Biol.
Anal. Chem.
ARE
1000 900 800 700 600 500 400 300 200 100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1 0

Figure 7


MPE for 13 weeks
125
100
75
50
0
Oper.
Oper.
Oper.
Oper.
Chem. Tech
Oper.
Chem. Tech
Chem. Tech
Oper.
Maint
1
2
3
4
5
6
7
8
9
10
Per Cent of Quarterly MPE
Employees By Code Number

b. Distribution and Processing Data of Film Meters

	Weekly Ave. to Date This Year	Deviation of This Year's Ave. from 1954 Weekly Average
West Portal	1783	-10.0%
East Portal	1644	79.9%
Visitors	461	31.0%
Ring film, packets, etc.	54	-59.4%
Routine neutron films	213	-03.2%
Special neutron films	162	710.0%
Calibrations	181	-11.7%
Correspondents	421	-80.0%
Special X-ray films	21	-30.0%
Total films handled	4310	-27.6%

c. Film Meter Data Loss

Badge meters not serviced	47	86.6%
Films lost	0	-100.0%
Films damaged	0	-100.0%
Total	47	85.0%

2. Investigations Initiated

a. From Pocket Meter Records

Significant total of 300 mr(ep) or more	.10	-91.6%
Off-scale pairs	1.65	-31.3%
Non-readable pairs	.02	0
Total	1.77	-51.0%

b. From Film Meter Records

Weekly PTR of 1000 mrep or more, or shield of 600 mr or more	2.87
Questionable PTR of 1000 mrep or more	.69
Lost or damaged films	.02
Average 100% or MPE/wk	2.87
Total	4.56

c. Investigation Results

	Investigated to Date This Year	Convirmed to Date This Year
Pocket Meters	88	41
Film Meters	261	263
Total	349	304

Paired off-scale pocket meters investigated to date this year	76
Legitimate number of off-scale pocket meter pairs to date	38
Statistical probability of spurious (paried off-scale) pocket meter readings to date this year	1.37

d. Laundry Decontamination Measurements

	Weekly Ave. to Date This Year	Dev. of This Year's weekly Ave. from 1954 Weekly Average
Garments	3785	-00.6%
Pairs of shoes for replacement	5	-72.2%
Special Items	1215	28.7%
Total	4662	-02.3%

SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

A re-scheduling of work assignments was necessary to give two-man coverage around the clock during the reactor experiment in Building 7503. This necessitated a 6-day work week which was of about 3 weeks duration.

In order to achieve better coordination of hot cell work and better control over radiation and contamination hazards in Building 3025, a Hot Cell Committee was formed. This committee will review all proposed hot cell work in detail, recommend procedures, impose limitations, etc. G. C. Cain is the Health Physics representative on this committee.

The operation in Building 3019 started this quarter necessitating additional Health Physics coverage in this area.

Activity Hazard Incident Report RS-132-54 was submitted on an incident involving the spread of radioactive material in Building 3019 on December 6, 1954.

SECTION V. TECHNOLOGICAL STUDIES

During this quarter, the effort of this Section was distributed as follows:

1.	Problems of Environs Group (reported under Assays-Instruments)	39%
2.	Special and Technical Problems	61%

The latter effort was principally devoted to the study of:

1.	Reactor Problems and Hazards	67%
2.	Other Technical Problems of Health Physics, including:	33%

a. Tritium Contamination Hazards

b. Contaminated Scrap Sale

c. AIHA Radiation Committee

d. Sundry Consultation on ORNL Problems

Of the reactor problems and hazards, the chief concern was preparation of data for Hazard Reports to the Reactor Safeguards Committee (ORR, HRT, and ART). Included in this are special problems arising in connection with the operation of the ARE.

J. C. Hart, Chief
Applied Health Physics

Data Compiled by: A. D. Warden
D. M. Davis
J. C. Ledbetter
T. J. Burnett
H. H. Abee
et. al.

JCH/mfm

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ORNL
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55-6-192
Copy No. 36

Oak Ridge National Laboratory

Health Physics Division

APPLIED HEALTH PHYSICS SEMI-ANNUAL REPORT

January - June 1955

DECLASSIFIED By Authority Of:
AEC - 4-10-58
P.A. Bonney
For: W. T. Bray, Supervisor
[redacted] Records Dept.
[redacted]

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38-62. File - AHP

[redacted]

SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

Air contamination in the Laboratory area based on samples collected by ten Continuous Air Monitors was considerably higher than that recorded during the last six months of 1954. These high values were determined to be the result of several contributing factors which included two chemical separations runs in Building 3026-D, a spill in Building 3505, and fallout from the Nevada tests.

The weekly average value for the first half of 1955 as recorded by ten Continuous Air Monitors was 7.5×10^{-12} µc/cc which is 710% greater than the average for the last half. The highest average value for the ten Air Monitors recorded in a single week occurred during the week ending March 14th, with an average of 7.7×10^{-11} µc/cc. A value of 3×10^{-10} µc/cc was the highest weekly average recorded on a single Air Monitor and was recorded during the same week. This is a factor of 33 less than the operating maximum permissible level for beta-gamma airborne activity.

The average radio-particulate count also showed an increase over that of last half. An average weekly count of 1.94 particles/1000 ft^3 of air sampled was found for the ten Continuous Air Monitors. This is an increase of 137% over that for the last half and 100% over the average value for all of 1954. The highest weekly particle count for a single Air Monitor occurred during the week ending April 18th with a count of 20.22 particles/ 1000 ft^3. The highest weekly average value for the ten Air Monitors was 6.97 particles /1000 ft^3, which occurred during the week ending April 25th.

The histogram on page 5, Figure 1, shows the weekly average radioparticulate count for the last half of 1954 and the first half of 1955. It should be noted that the peak counts occurred during the Nevada testing period indicating this to be a significant contribution.

Beta activity in the effluent discharged from White Oak Lake increased 7.0% over the value recorded for last half of 1954. The calculated probable weekly average concentration in the Clinch River was 1.28×10^{-7} µc/cc (Fig. 2, p. 6). This value is 12.3% greater than the last half of 1954. The operating limit of 10^{-7} µc/cc was exceeded 46% of the time as illustrated by Fig. 3, p. 7. The per cent MPC based on radiochemical analysis of White Oak Lake effluent is shown in Fig. 4. From the actual analyses, it is observed that the concentration in the Clinch River averaged 31.3% of the MPC_w.

Area background measurements were taken monthly and reported separately. The average monthly background for the Laboratory area was found to be 11% less than that for the last half of 1954 and 26% less than the 1954 yearly average.

[redacted]

Of the garments going to commercial laundries for cleaning, 3.9% were held out as exceeding maximum permissible limits. A total of 51,634 garments were checked for contamination during this period. A plot of the weekly fluctuations is given in Fig. 5, p. 9, showing a rising trend in clothing contamination during the first six months of 1955 although the average for the period was less than that recorded for the last half of 1954.

A series of tests on the decontaminating efficiency of the present laundry procedure was conducted during this period. A decontamination efficiency of 95.3% was found. A report, CF 55-5-203, showing the complete results has been issued separately.

Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

		Average Long Lived Activity	
Station Number	Location	Wkly Av. to Date This Year, Conc. x 10^{-13} µc/cc	Deviation from 1954 Weekly Average
HP-1	N 3550	245.07	+614.7%
HP-2	S 3001	89.87	- 97.7%
HP-3	S 1000	45.86	+ 26.4%
HP-4	W 3513	19.05	+200.5%
HP-5	E 2506	236.75	+241.3%
HP-6	SE 3012	30.02	- 95.6%
HP-7	W 7001	24.59	+206.6%
HP-8	Rock Quarry	12.15	+195.6%
HP-9	A-10 Site	21.07	+215.9%
HP-10	S 2007	29.06	+ 89.9%
Average		75.35	

Deviation of this year's average long lived activity to date from last year's average - 84.2%

[redacted]

2. Particulate Studies

a. CAM Filter

Number	Location	$<10^5$	$10^5 - 10^6$	$10^6 - 10^7$	$>10^7$	Total	Weekly Av. to Date This Year Particles Per 1000 cu. ft.	Deviation of Wkly. Av. to Date This Year from Wkly. Av. Last Year
HP-1	N 3550	116.92	4.92	0.04	0.00	121.92	2.43	+ 67.6%
HP-2	S 3001	88.23	4.69	0.23	0.04	93.19	1.84	+ 46.0%
HP-3	S 1000	69.88	4.77	0.27	0.00	74.92	1.48	+174.1%
HP-4	W 3513	40.77	2.27	0.04	0.00	43.08	0.84	+133.3%
HP-5	E 2506	257.23	3.73	0.23	0.00	261.19	5.17	+ 54.8%
HP-6	SE 3012	52.50	2.96	0.19	0.00	55.65	1.09	+ 62.7%
HP-7	W 7001	58.62	3.04	0.07	0.00	61.73	1.21	+175.0%
HP-8	Rock Quarry	80.42	1.96	0.04	0.00	82.42	1.60	+384.8%
HP-9	A-10 Site	92.50	2.42	0.15	0.00	95.07	1.86	+257.7%
HP-10	S 2007	91.50	2.15	0.00	0.00	93.65	1.84	+132.9%
Average							1.94	
Deviation of this year's weekly average to date from weekly average last year								+100.0%

3. Meteorological Data

a. Rainfall

Total this Year	31.50 inches
Normal Yearly Rainfall	52.04 inches
Deviation From Normal Seasonal Rainfall	+15.4 %

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin Beta	White Oak Lake Beta
Weekly av. to date this year	4.29	9.80
Deviation from 1954 weekly average	+4.9%	+32.8%

b. Submersion Data

Weekly Av. to Date This Year	Settling Basin Beta Mrep/hr	Settling Basin Gamma mr/hr	Settling Basin Total mr(ep)hr	White Oak Lake Beta Mrep/hr	White Oak Lake Gamma mr/hr	White Oak Lake Total mr(ep)hr
	0.310	0.217	0.527	0.024	0.013	0.037
Deviation From 1954 Weekly Average	-37.3%	-58.8%	-48.4%	-33.3%	-55.2%	-43.1%

c. Plutonium Discharged

	Settling Basin Conc. x 10^{-9} µg/cc	Settling Basin Total 1 mg. Plutonium	White Oak Lake Conc. x 10^{-9} µg/cc	White Oak Lake Total mg Plutonium
Weekly Av. to Date This Year	5707.2	85.359	298.4	119.732
Deviation from 1954 Weekly Average	+86.9%	+187.2%	+202.9%	+427.3%

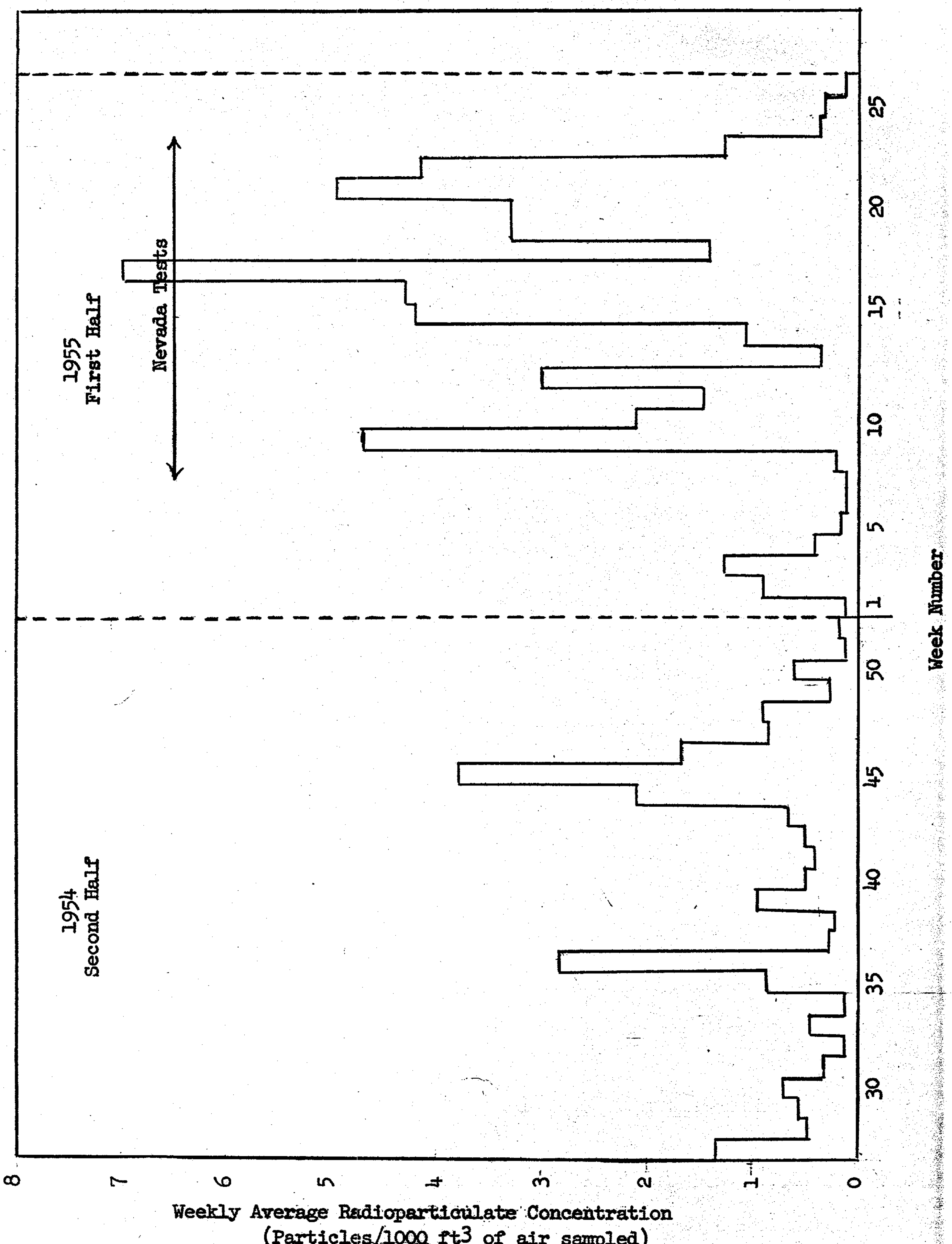
d. Probable Average Concentration in Clinch River Below White Oak Creek using as a dilution factor the ratio of White Oak Lake discharge to the flow of Clinch River.

Weekly Average to Date This Year	1.27×10^{-7} µc/cc
Deviation from 1954 weekly Average	-23.4%

[redacted]

Figure 1

Air Particulate Activity
Average of 10 CAM's



[redacted]

Figure 2

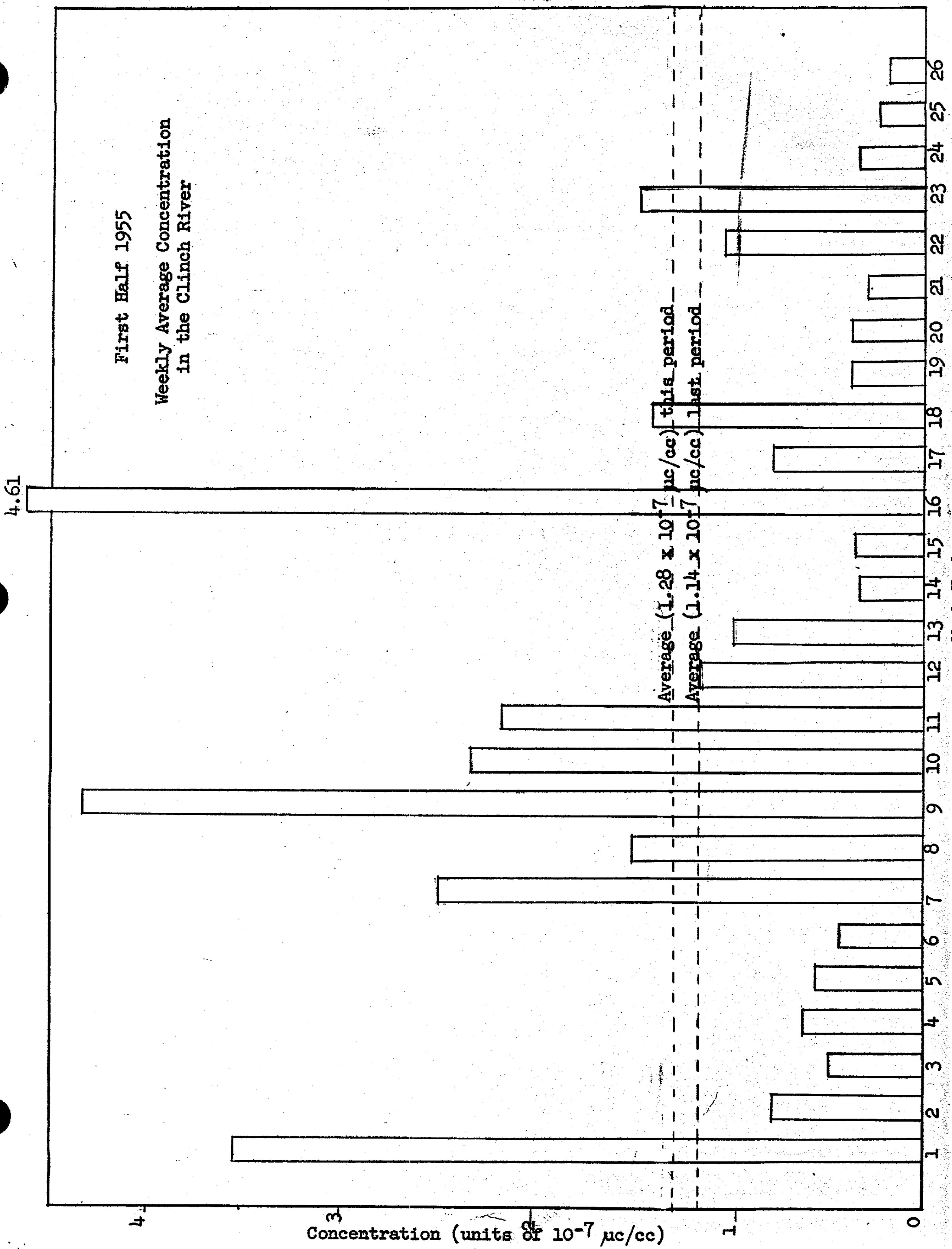


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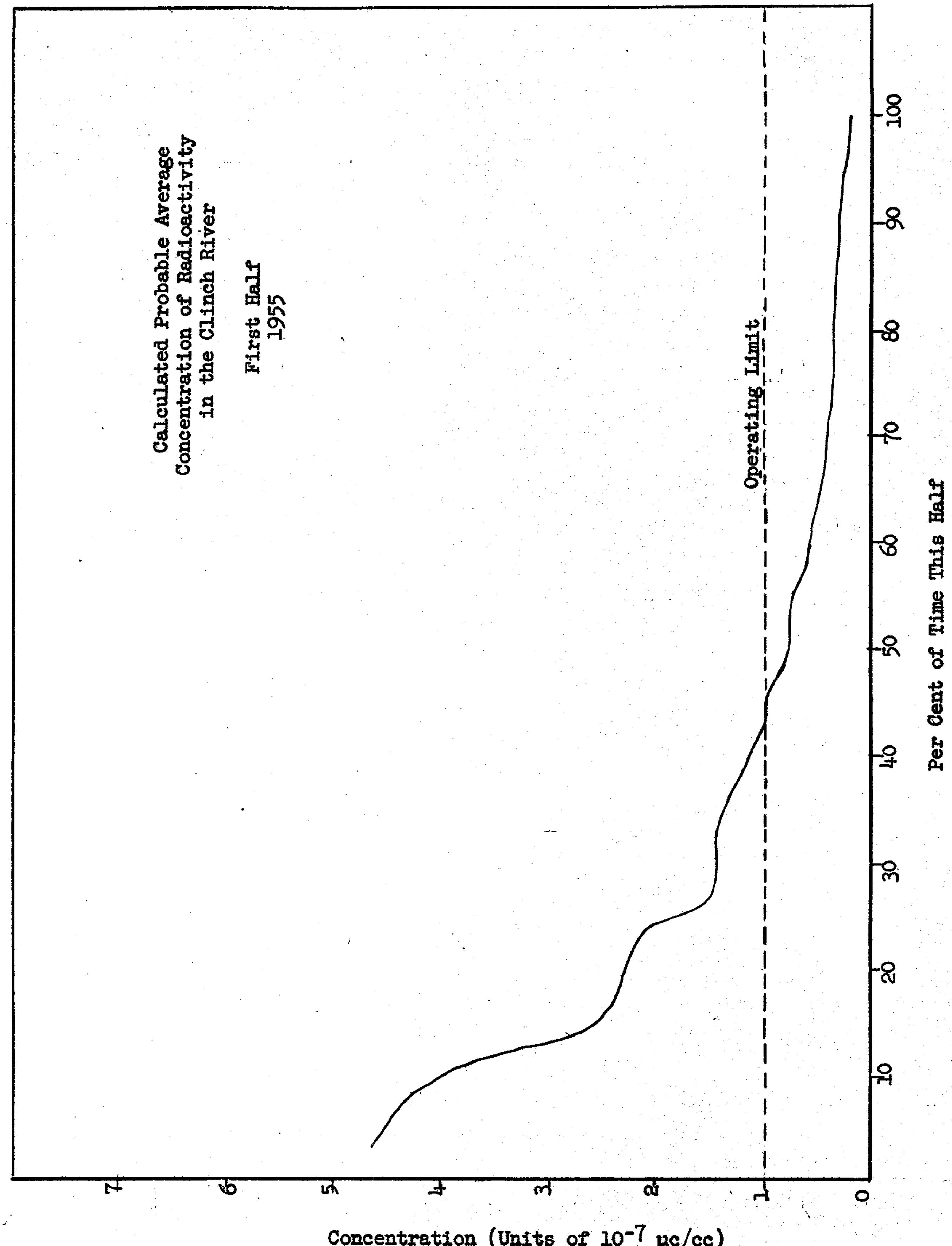
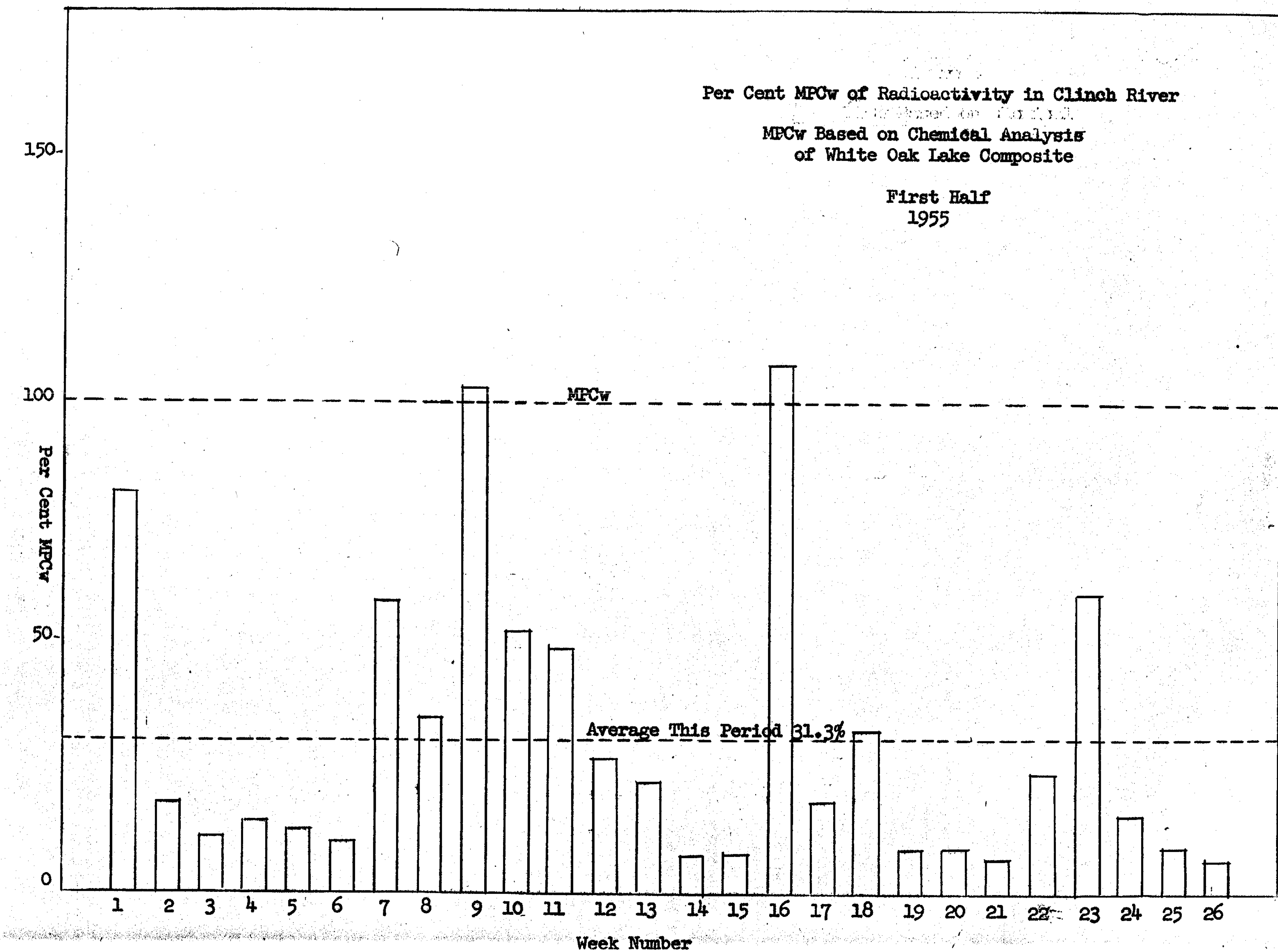
Figure 3

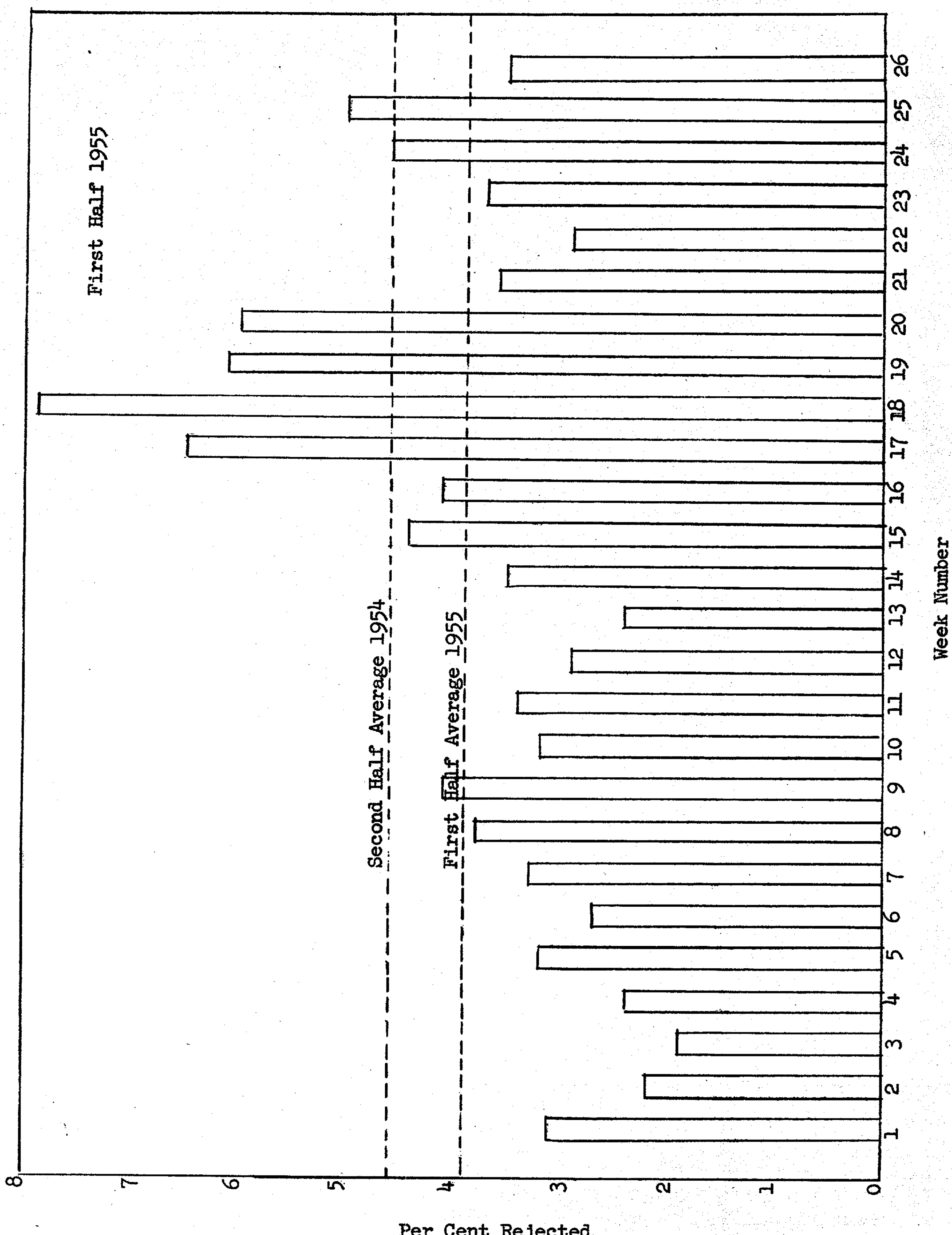



Per Cent MPCw of Radioactivity in Clinch River
MPCw Based on Chemical Analysis
of White Oak Lake Composite
First Half
1955
MPCw
Average This Period 31.3%
Per Cent MPCw
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Week Number

[redacted]

Figure 5

Contamination Rejects of Garments
Subject to Commercial Laundering



SECTION II. ASSAYS - INSTRUMENTS

Part A. Salient and Non-Routine Items

An automatic sample changing continuous reading beta-gamma air sampler has been constructed and is being field tested. The basic components are a commercial smoke sampler, counting rate meter, and recorder.

A device for the measurement of H^3 in liquid samples, based upon the descriptions in Report LA-1678, has been fabricated and is being assembled.

An impactor type air sampler for particle mass differentiation for collection of airborne alpha activity is being fabricated. The impactor will be constructed according to designs reported in CR-HP-577. Modifications will be made on the impactor to adapt it to instruments currently available.

Three "off-area" emergency kits have been equipped for use in the "off-area" emergency program. Four additional kits are proposed.

A technique for the preparation of gum paper "fall out" samples for counting was developed and put into use. The technique consists of fixing the ashed sample to the counting dish with a plastic spray to prevent repositioning and/or loss of sample during the counting process. A paper by J. M. Davis describes the technique.

A total of 45 "well logs" were made during this period. There were 29 made in connection with the lagoon survey project. The highest reading observed was approximately thirty times background. This reading was observed in hole No. 58, which is near waste pit No. 3. The highest reading recorded in the Laboratory area was twice background and was observed in a caved-in well (#39) at a depth of 18.5 feet. The water in this well indicated a gross beta count of <1 c/m/ml at 10% geometry.

The Laboratory work and the evaluation of data from the 1954 river survey were completed. A report of the survey has been submitted to the pre-publication review committee.

A scintillation counter, originally built for well logging was received, calibrated, and modified for use in the 1955 river survey. This instrument appears to have approximately twice the sensitivity of the "flounder" (series of GM tubes) and in addition is less bulky and easier to handle in the field. Additional tests will be carried on during the 1955 river survey.

Chemical dosimetry equipment is being installed. A portion of the basic apparatus is in operation.

A report bringing personnel monitoring techniques up to date at the Laboratory entitled "Current Practices in Film Dosimetry at ORNL" has been completed and is available for local distribution.

A paper entitled "Proposed Methods for Dosage Determination in Mixed Beta-Gamma X-Ray Film Dosimetry" was presented at the Health Physics Conference at Ohio State University by E. D. Gupton.

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services - (Weekly Average)

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Alpha	Beta	Units Per Count*	Total Units
Smears		2548	2607	1	5155.0
Air Samples	180.6	204.5	213.1	3	1794.6
Applied Radiobiology			138.5	4	554.0
Area Monitoring		7.9	73	4	324.0
Environmental Studies			71.9	4	287.5
ERDL			15.2	4	60.8
Decay and Absorption Studies	71			4	142.0

Average Units Per Week This Report	8938.7
Deviation of weekly average this report from 1954 Weekly Average	+3.0%
Total units handled to date this year	232,414
Deviation of weekly average to date this year from 1954 weekly average	+3.0%

* Unit = 2/3 min.

b. Chemical Analysis

	Weekly Average
Pu	16.3
U	24.9
Sr	20.5

b. (Continued)

Chemical Analysis	Weekly Average
Gross Alpha	5.9
Pa	0.1
Lead (Urine)	2.1
(Blood)	0.6

Average number of Samples per Week	70.4
Deviation of weekly average this report from 1954 weekly average	+14.6%
Total samples handled to date this year	1822
Deviation of weekly average to date this year from 1954 weekly average	+14.6%

2. Environs

a. Air Activity Studies

Type Sample	Av. No. of Samples Per Wk/Station	No. Stations	Total Samples For Quarter
Water	1.03	4	107
Filter	1.03	4	107
Gum Paper	50.98	4	622
Total	7.94	Total	836

3. Calibration Unit

a. Film Routine

Average number of films calibrated per week	193
Deviation of the weekly average this report from 1954 weekly average	- 33%
Total films calibrated	5006
Deviation of weekly average to date this year from 1954 weekly average	- 33%

b. Instrument Routine

Average number of instruments calibrated per week	95
Deviation of the weekly average this report from 1954 weekly average	- 10%
Total instruments calibrated	2472
Deviation of weekly average to date this year from weekly average of 1954	- 10%

4. Portable Instruments Repaired

a. Average number of instruments repaired per week	52
b. Deviation of the weekly average this report for weekly average of 1954	+ 10%
c. Total instruments repaired to date this year	1361
d. Deviation of weekly average to date this year from weekly average of 1954	+ 10%

5. Operation of Fixed and Semi-Portable Instruments*

	1	2	3	4	5	6
a. Constant Air Monitors	8255	4199	4056	219	49%	2.7%
b. Monitrons	9906	5196	4710	112	48%	1.1%

*Explanation for Column Headings:

1. Total number of "Instrument Days" where an "Instrument Day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operations reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Per cent of "Instrument Days" not reported.
6. Per cent of "Instrument Days" instrument reported out of service.

5. (Cont'd) Operation of Fixed and Semi-Portable Instruments

		1	2	3	4	5	6
c.	Hand & Foot Counters	1397	635	762	75	55%	5.3%
d.	AC Poppies (Alpha and Beta-Gamma)	2921	1467	1454	11	50%	.37%
e.	Scalers (including alpha counters)	3556	2035	1521	19	43%	.53%
f.	Precipitrons	1778	978	800	0	44%	0%
g.	Friskers	1397	890	507	62	36%	4.4%
h.	Filtrons	1270	502	768	0	60%	0%
i.	Disc Air Samplers	1905	1045	860	299	45%	15.7%

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

The special NTA film developed by J. S. Cheka, Oak Ridge National Laboratory, and produced by the Eastman Corporation, is now in use in the Personnel Monitoring badges. The special NTA film packet contains a high range gamma film (5302) and thus eliminates the need for the high range (606) film in the beta-gamma packet. Consequently, the DePont 552 packet (film 502, 510) has replaced the DuPont 553 packet (film 502, 510 and 606).

Fig. 6 p. 18, is a breakdown by Laboratory Division showing the number of significant exposures and the number of cases where the weekly MPE is exceeded. It is noted that the number of cases where the weekly MPE is exceeded has increased by a factor of approximately 2 over the average for last year (1954).

Fig. 7, p. 19, is a breakdown by Laboratory Divisions showing the number of overage weeks and the number of persons involved. There were 449 persons involved in over exposures for a total of 1227 overage weeks. This is appreciably higher than the 1954 exposures.

Fig. 8, p. 20, is a plot showing the exposure total of the ten employees sustaining the highest exposure for the first half of 1955. Although the weekly MPE was exceeded 449 times, no employee received more than permissible doses for the six month period as defined by the Bureau of Standard Handbooks 52 and 59.

Part B. Statistical Data

1. Personnel Meters

a. Distribution and Performance of Pocket Meters

	Weekly Av. To Date This Year	Deviation of This Year's Av. from 1954 Weekly Average
Meters distributed	4422	- 04.3%
Readable meters	4417	- 04.3%
Non-readable meters	4	0
Non-readable pairs	0	-100.0%
Off-scale readings	16	0
Off-scale pairs	2	21.2%

	Weekly Av. to Date This Year	Deviation of This Year's Weekly Av. from 1954 Weekly Average
b. Expected Off-Scale Pocket Meter Pairs	.03	
c. Distribution and Processing Data of Film Meters		
West Portal	1976	10.8%
East Portal	1200	-27.0%
Visitors	698	51.4%
Ring films, packets, etc.	140	159.3%
Routine neutron films	210	-01.4%
Special neutron films	188	16.0%
Calibrations	177	-02.2%
Correspondents	93	-77.9%
Special X-ray films	15	-28.6%
Total films handled	4694	08.9%
d. Film Meter Data Loss		
Badge meters not serviced	59	25.5%
Films lost	0	0
Films damaged	0	0
Total	59	25.5%

2. Investigations Initiated

a. From Pocket Meter Records		
Significant total of 300 mr(ep) or more	0	-100.0%
Off-scale pairs	1.96	18.8%
Non-readable pairs	0	-100.0%
Total	1.96	10.7%
b. From Film Meter Records		
Weekly PTR of 1000 mrep or more, or shield of 600 mr or more	5.32	85.4%
Questionable PTR of 1000 mrep or more	1.04	50.7%
Lost or damaged films	.08	300.0%
Average 100% of MPE/Wk	7.19	150.5%
Total	13.96	206.1%

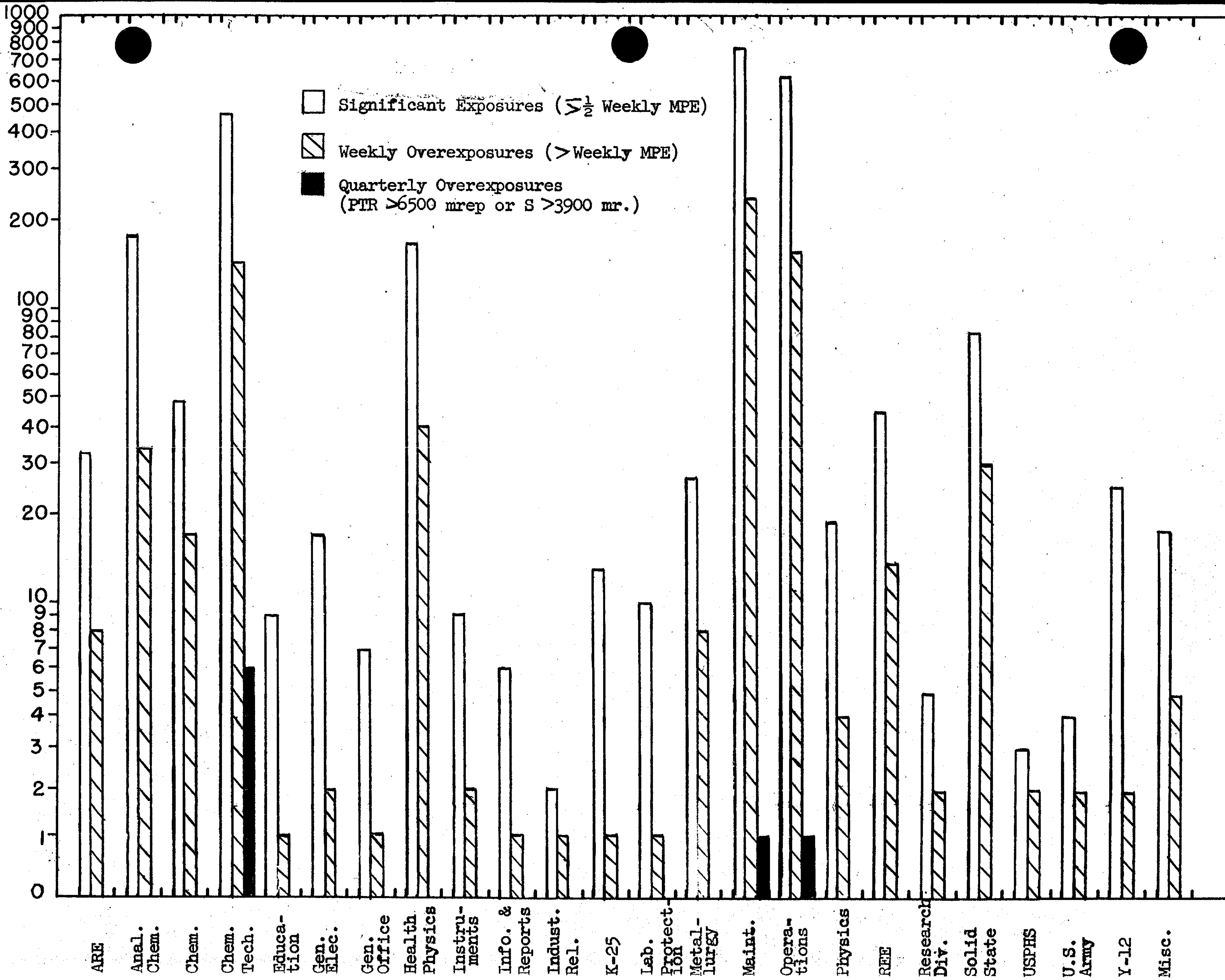
c. Investigation Results

	Investigated to Date This Year	Confirmed to Date This Year
Pocket Meters	47	37
Film Meters	422	160
Total	469	197

Paired off-scale pocket meters investigated to date this year	47
Legitimate number of off-scale pocket meter pairs to date	37
Statistical probability of spurious (paried off-scale) pocket meter readings to date this year	.61

d. Laundry Decontamination Measurements

	Weekly Av. To Date This Year	Dev. of This Year's Weekly Av. from 1954 Weekly Average
Garments	4124	08.9%
Prs. of Shoes for Replacement	9	80.0%
Special Items	1500	23.5%
Total	4198	-09.9%


Significant Exposures (≥½ Weekly MPE)
Weekly Overexposures (>Weekly MPE)
Quarterly Overexposures
(PTR >6500 mrep or S >3900 mr.)
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
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10
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4
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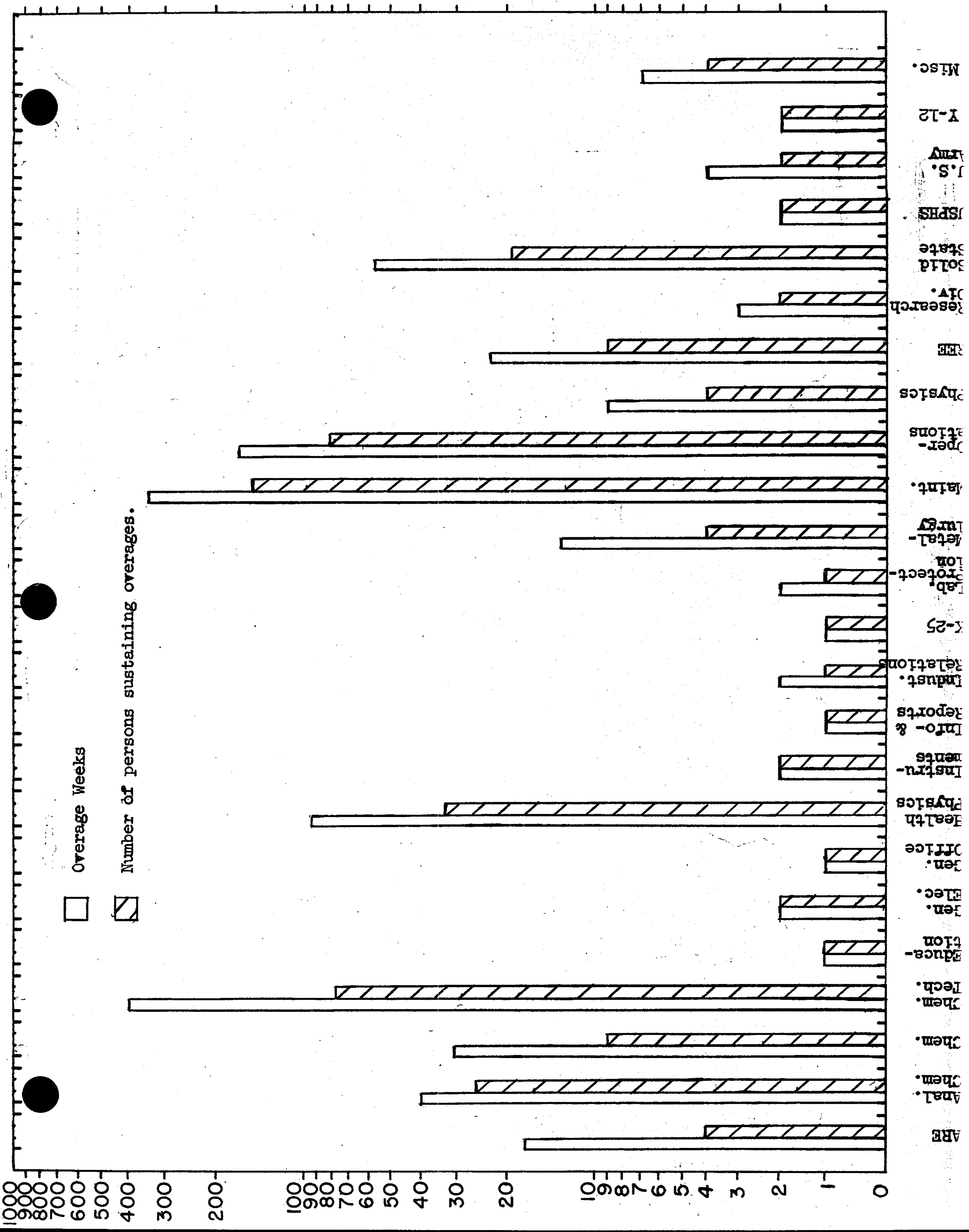
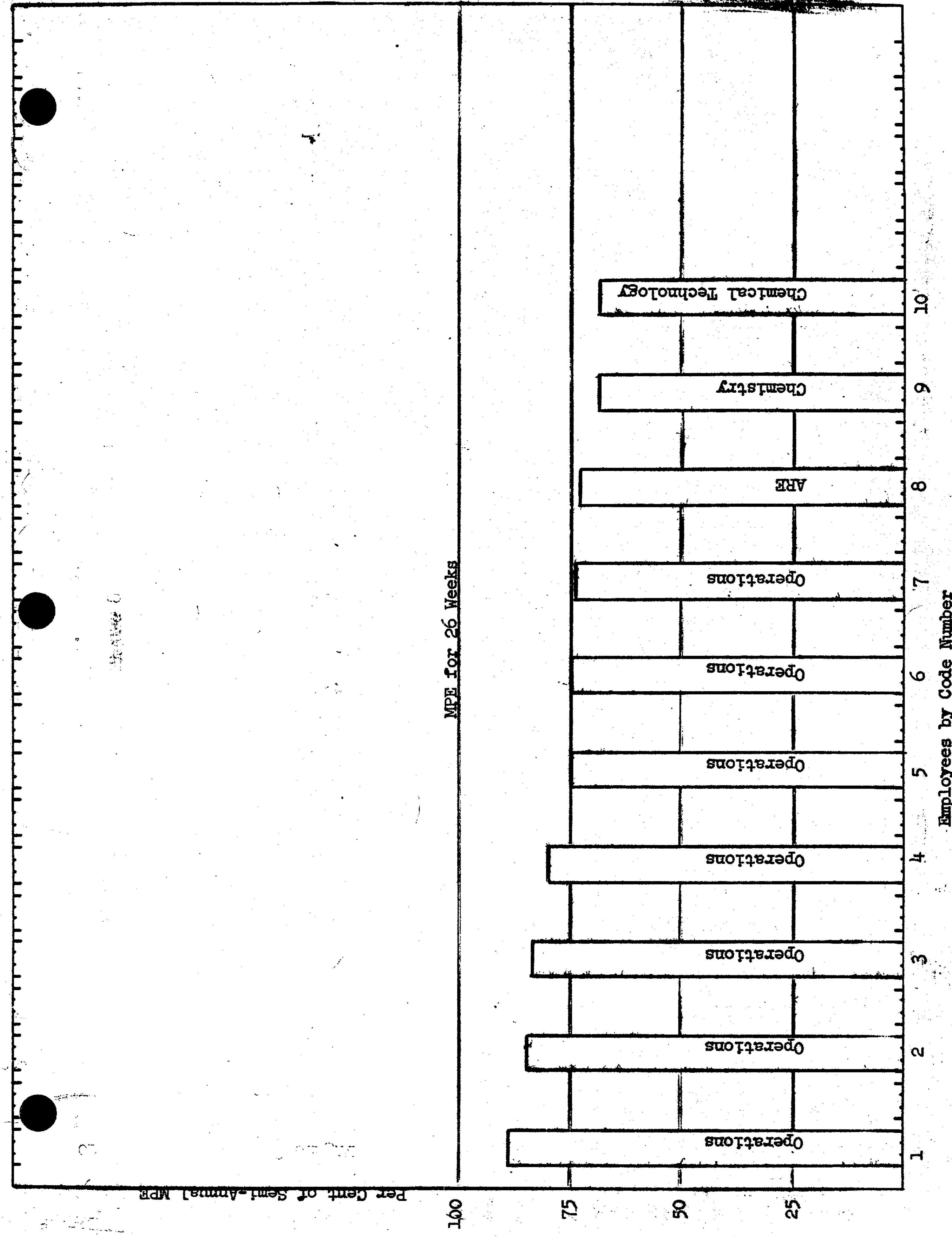
2
1
0
ARE
Anal. Chem.
Chem.
Chem. Tech.
Educa- tion
Gen. Elec.
Gen. Office
Health Physics
Instru- ments
Info. & Reports
Indust. Rel.
K-25
Lab. Protect- ion
Metal- lurgy
Maint.
Opera- tions
Physics
REE
Research Div.
Solid State
USPHS
U.S. Army
Y-12
Misc.

Figure 7



Overage Weeks
Number of persons sustaining overages.
ARE
Anal. Chem.
Chem.
Chem. Tech.
Educa-tion
Gen. Elec.
Gen. Office
Health Physics
Instru-ments
Info- & Reports
Indust. Relations
K-25
Lab. Protect-ion
Metal-lurgy
Maint.
Oper-ations
Physics
Research Div.
Solid State
USPHS
U.S. Army
Y-12
Misc.
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
900
1000

Figure 8


MPE for 26 Weeks
Per Cent of Semi-Annual MPE
100
75
50
25
Employees by Code Number
1
2
3
4
5
6
7
8
9
10
Operations
Operations
Operations
Operations
Operations
Operations
Operations
ARE
Chemistry
Chemical Technology

SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

General:

Four members of the Radiation Survey Section were away from the Laboratory on special assignments during the early months of the year.

Members of the AEC Fellowship group started field training during the month of June. The training program will be completed in September.

Reactors, Accelerators and Related Physics Surveys

The semi-annual film survey of the particle background in the 3000 area was done during January and February. Forty films ($6\frac{1}{2}$ x $8\frac{1}{2}$) were exposed for a three week's period in Building 3001, 3004, 3005, and 3025. Results indicated no significant build-up in particulate contamination.

The main task of dismantling and removing contaminated equipment from Building 7503 was essentially completed during this period. Special precautions were taken to minimize exposure and contamination spread during this operation.

Health Physics services were provided during assembly and testing to the Geneva Conference reactor at the BSF during this period.

A fuel loop experiment at the LITR gave rise to air activity on June 30, requiring the evacuation of the LITR and BSF. Conditions were corrected within a short time permitting resumption of normal operations. Reference: Activity Hazard Incident Report RS-116-55.

A ruptured source containing approximately 2 millicuries of Thorium resulted in the contamination of Building 3010, and the first level north in Building 3001. The incident was discovered April 13, at which time effective decontamination measures were taken. Details are given in Activity Hazard Incident Report, RS-108-55.

General Research, Chemistry and Operations Survey

Four incidents involving accidental releases of radioactive materials occurred in Building 3019 during the period covered by this report. Three of the incidents resulted in both building and personnel contamination problems; one incident involved only personnel contamination. The incidents were controlled and cleaned up without excessive exposure to personnel. Reference: Activity Hazard Incident Report, RS-101-55 "Possible Internal Contamination Incident" May 23; Activity Hazard Incident Report, RS-111-55, "Spill at 3019".

During the extensive decontamination and equipment removal program in Building 3505, two incidents occurred involving building and personnel contamination. One of the incidents occurred on February 28, and resulted in general contamination of the dock and sampling gallery areas. The other incident occurred on March 7 and resulted in heavy contamination around the off-gas stock, new dock area, southeast roof of building, and ground area south of the building. A clean-up campaign, instituted immediately, was effective in reducing the contamination to safe working levels. References: Activity Hazard Incident Reports, RS-136-55 and RS-137-55.

Reports were also submitted during this period regarding incidents occurring in Building 4500, 4505, 3508, and 3550. Normal functions were allowed to resume within a short time after decontamination procedures had been successfully carried out. References: Activity Hazard Incident Reports, RS-107-55 and RS-109-55 entitled" Incident in Building 4505", June 15 and "Floor Contamination of Building 3508", January 1.

General Surveys

During this period a liquid waste spill occurred on the south tank farm area. The spill was the result of faulty transfer lines. Approximately 1,500 gallons of liquid waste was involved, and four weeks were required to monitor the clean-up and dispose of the spill. Reference: Activity Hazard Incident Report dated April 15, "Spill of Hot Waste in the South Tank Farm".

Periodic checks of the main Laboratory roads and streets were instituted during the past six months. The checks are made using an improvised instrument consisting of a series of GM tubes mounted on a frame fastened to the rear bumper of a pick-up truck. This method of monitoring has resulted in the location of several contaminated spots on the Laboratory roads and streets.

A routine monitoring program has been set up for checking the waste transfer line which runs from the tank farm to the lagoon area. This is being done in order to determine whether or not leaks may develop in the line.

SECTION V. TECHNOLOGICAL STUDIES

During the first half of 1955, the effort of this Section was distributed as follows:

1.	Problems of Environs Group (reported under Assays-Instruments)	19%
2.	Special and Technical Problems	81%

The latter effort was principally devoted to the study of:

1.	Reactor Problems and Hazards	56%
2.	Other Technical Problems of Health Physics, including:	44%

a. Relative Hazards, Radon vs. Thoron

b. MPCw for White Oak Lake Analyses

c. Particulate Levels at ORNL vs. off area Background

d. Participation in Health Physics Exhibit - AIHA

e. Sundry Consultation on ORNL problems.

Of the reactor problems and hazards, the major efforts were applied to an evaluation of the hazards of mixed fission products in a general manner readily applicable to any reactor, to the buiding leakage hazard for the ORR and to calculations for the ART relative to its safety and off-gas system design. In addition, studies were made of some hazard aspects of the APPR, of hazard improvement by treatment of homogeneous reactors, and of Project Aquarium.

J. C. Hart, Chief
Applied Health Physics

Data Compiled by: A. D. Warden
D. M. Davis
J. C. Ledbetter
T. J. Burnett
H. H. Abee
et. al.

JCH:mfm

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Oak Ridge National Laboratory

Health Physics Division

APPLIED HEALTH PHYSICS SEMI-ANNUAL REPORT

January 1956 - July 1956

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For: N. T. Bray, Supervisor
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SECTION I. AREA MONITORING

Part A. Salient and Non-Routine Items

The weekly average value for air activity during the period based on samples collected by ten continuous air monitors was 3.6×10^{-12} µc/cc which is 47.3% greater than that encountered last half. The highest average activity recorded for a single week was 1.9×10^{-11} µc/cc, which occurred during the week ending January 9, 1956. The highest average activity recorded by a single air monitor was 8×10^{-11} µc/cc which is less than the maximum permissible level for beta-gamma activity by a factor of 12.5.

Radioparticulate activity also showed an increase over that of the last period with an average for the period of 1.59 particles per 1000 ft^3 of air sampled. This is an increase of 89.3% over the last half. The highest average count occurred during the week ending April 30, 1956 with a count of 3.8 particles per 1000 ft^3 being recorded. The highest particle count recorded by a single air monitor was 26.61 particles per 1000 ft^3 and occurred during the week ending July 2, 1956. Fig. 1 is a plot of this data.

The radioactive constituents of the White Oak Creek discharge increased by 101% over the values recorded for the last period. Much of this occurred in the early part of the year as a result of several releases from the Laboratory coupled with a scouring out of the mud in White Oak Lake basin by early rains. The operating limit of 10^{-7} µc/cc for gross activity was exceeded 51% of the time during the period as illustrated in Fig. 2. The weekly average fluctuation in the Clinch River is illustrated in Fig. 3. Radiochemical analysis data shown in Fig. 4 indicates that the average concentration for the period was about 30.6% of the MPCw.

Area background measurements were made on a monthly basis and reported separately. The average monthly background for the period was found to be 3.1% greater than last half and 2% less than the average for last year.

A total of 101,688 garments were checked for contamination by the Laundry Monitoring Unit. Of those checked, 10,557 were found to be above maximum permissible limits. Of the garments going to commercial laundries for cleaning, 3.4% were found to be above maximum permissible limits. The histogram on page 9 Fig. 5, shows the weekly fluctuations in per cent contaminated khaki garments during the period.

Beginning with the first of this period, the responsibility for the activities of the Environs Group was transferred to the Area Monitoring Section from the Assay-Instruments Section. During the period, the group activated air sampling stations at all of the AEC Perimeter Guard Portals and at Hickory Creek Bend on the Clinch River. Each station is equipped to sample air by filtering and to collect fall-out by gum paper and rain-out techniques.

Part B. Statistical Data

1. Air Activity

a. Constant Air Monitors

Station Number	Location	Average Long Lived Activity: Weekly Av. to Date this Year, Conc. x 10^{-13} µc/cc	Deviation From 1955 Weekly Av.
HP-1	N 3550	47.83	- 67.6%
HP-2	S 3001	22.85	- 58.5%
HP-3	S 1000	28.29	- 19.4%
HP-4	W 3513	25.82	+ 48.0%
HP-5	E 2506	140.02	- 4.5%
HP-6	SE 3012	15.87	- 24.2%
HP-7	W 7001	15.15	- 11.5%
HP-8	Rock Quarry	9.07	+ 12.8%
HP-9	A-10 Site	16.90	- 41.5%
HP-10	E 2074	38.02	+ 31.7%
Average		35.98	

Deviation of this year's average long lived activity to date from last year's average - 27.1%

2. Particulate Studies

a. CAM Filters

Number	Location	Particle Distribution-Weekly Average Number of Particles — *Activity Ranges - Dis/24 hours: *$<10^5$	$10^5 - 10^6$	$10^6 - 10^7$	$>10^7$	Total	Weekly Av. to Date This Year Particles Per 1000 cu. ft.	Deviation of Wkly. Av. to Date this Year From Weekly Av. Last Year
HP-1	N 3550	76.08	2.04	0.00	0.00	78.12	1.99	+ 8.7%
HP-2	S 3001	39.04	2.12	0.07	0.00	41.23	0.82	- 39.7%
HP-3	S 1000	45.92	2.65	0.00	0.00	48.57	0.97	- 1.0%
HP-4	W 3513	30.50	2.31	0.00	0.00	32.81	0.88	+ 27.5%
HP-5	E 2506	292.92	4.92	0.00	0.00	297.84	5.39	+ 54.0%
HP-6	SE 3012	45.96	1.35	0.00	0.00	47.31	0.91	+ 1.1%
HP-7	W 7001	34.81	1.96	0.00	0.00	36.77	0.84	+ 5.0%
HP-8	Rock Quarry	28.32	1.48	0.00	0.00	29.80	0.62	- 41.0%
HP-9	A-10 Site	38.96	1.88	0.00	0.00	40.84	1.05	- 13.9%
HP-10	E 2074	84.88	2.00	0.00	0.00	86.88	2.45	+ 70.1%
Average							1.59	

Deviation of this year's weekly average to date from weekly average last year + 15.2%

3. Meteorological Data

a. Rainfall

Total This Year	33.44 inches
Normal Yearly Rainfall	52.58 inches
Deviation from normal seasonal rainfall	+ 17.6%

4. Liquid Waste Disposal

a. Curies Discharged

	Settling Basin Beta	White Oak Lake Beta
Weekly Av. to date this year	5.04	13.53
Deviation from 1955 weekly average	+ 21.7%	+ 64.2%

b. Submersion Data

	Settling Basin			White Oak Lake		
	Beta mrep/hr	Gamma mr/hr	Total mr(ep)hr	Beta mrep/hr	Gamma mr/hr	Total mr(ep)hr
Weekly Av. to Date This Year	0.292	0.293	0.585	0.039	0.040	0.079
Deviation From 1955 Weekly Av.	- 5.2%	+11.8%	+ 2.6%	+ 2.6%	+81.8%	+31.7%

c. Plutonium Discharged

	Settling Basin		White Oak Lake	
	Conc. x 10^{-9} µg/cc	Total mg Plutonium	Conc. x 10^{-9} µg/cc	Total mg Plutonium
Weekly Av. to Date this Yr.	2867.5	49.010	386.9	103.911
Deviation from 1955 Weekly Average	- 26.0%	- 15.7%	+ 28.1%	+ 36.4%

d. Probable average concentration in Chinch River below White Oak Creek using as a dilution factor the ratio of White Oak Lake discharge to the flow of Clinch River.

Weekly Av. to Date this year	1.92×10^{-7} µc/cc
Deviation from 1955 Weekly Average	+ 53.6%

5. Laundry Decontamination Measurements

	Weekly Av. to Date This Year	Deviation of this Year's weekly av. from 1955 weekly av.
a. Garments	3910	+ 1.1%
b. Special Items	3190	+34.9%

[redacted]

Figure 1

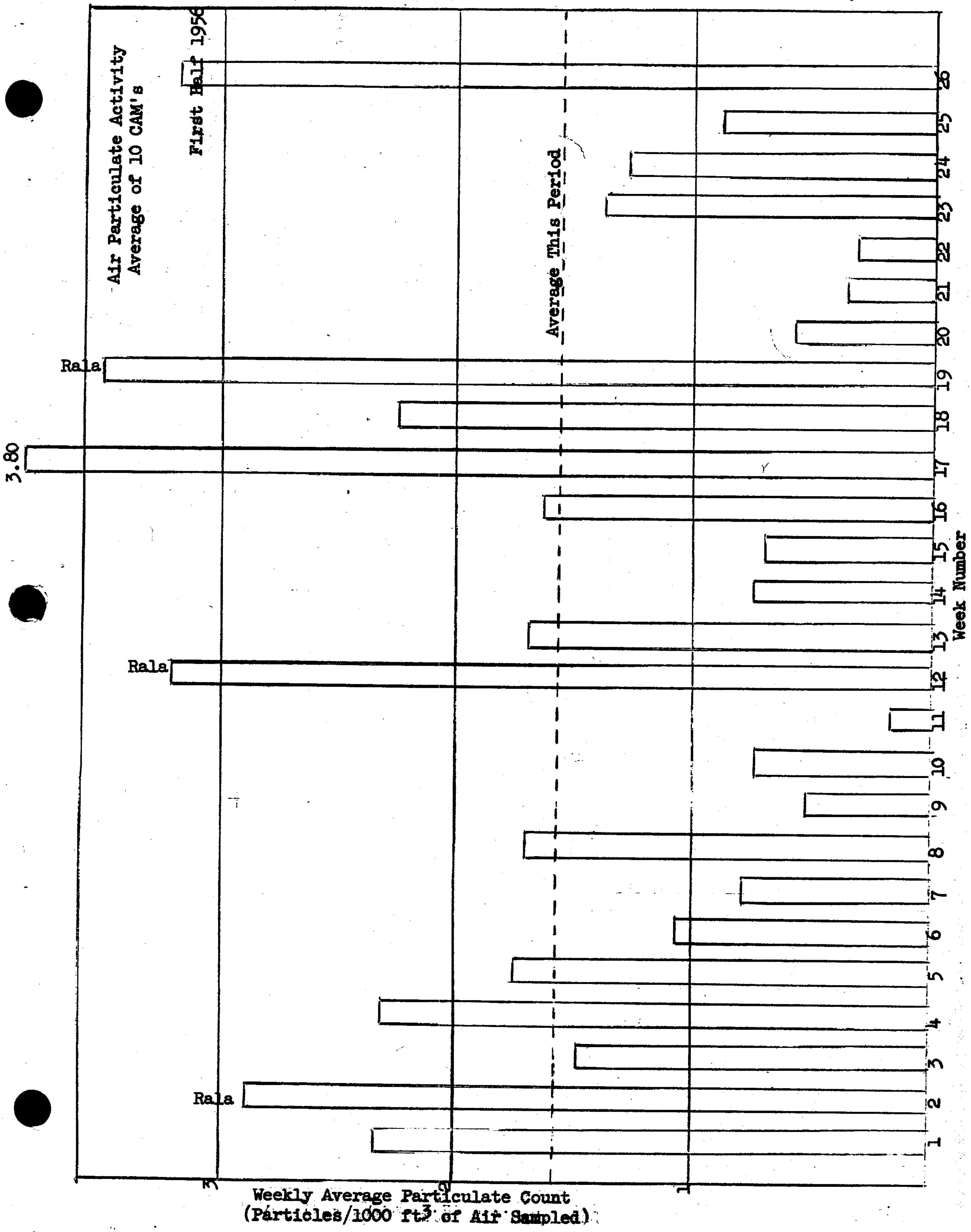

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Figure 2

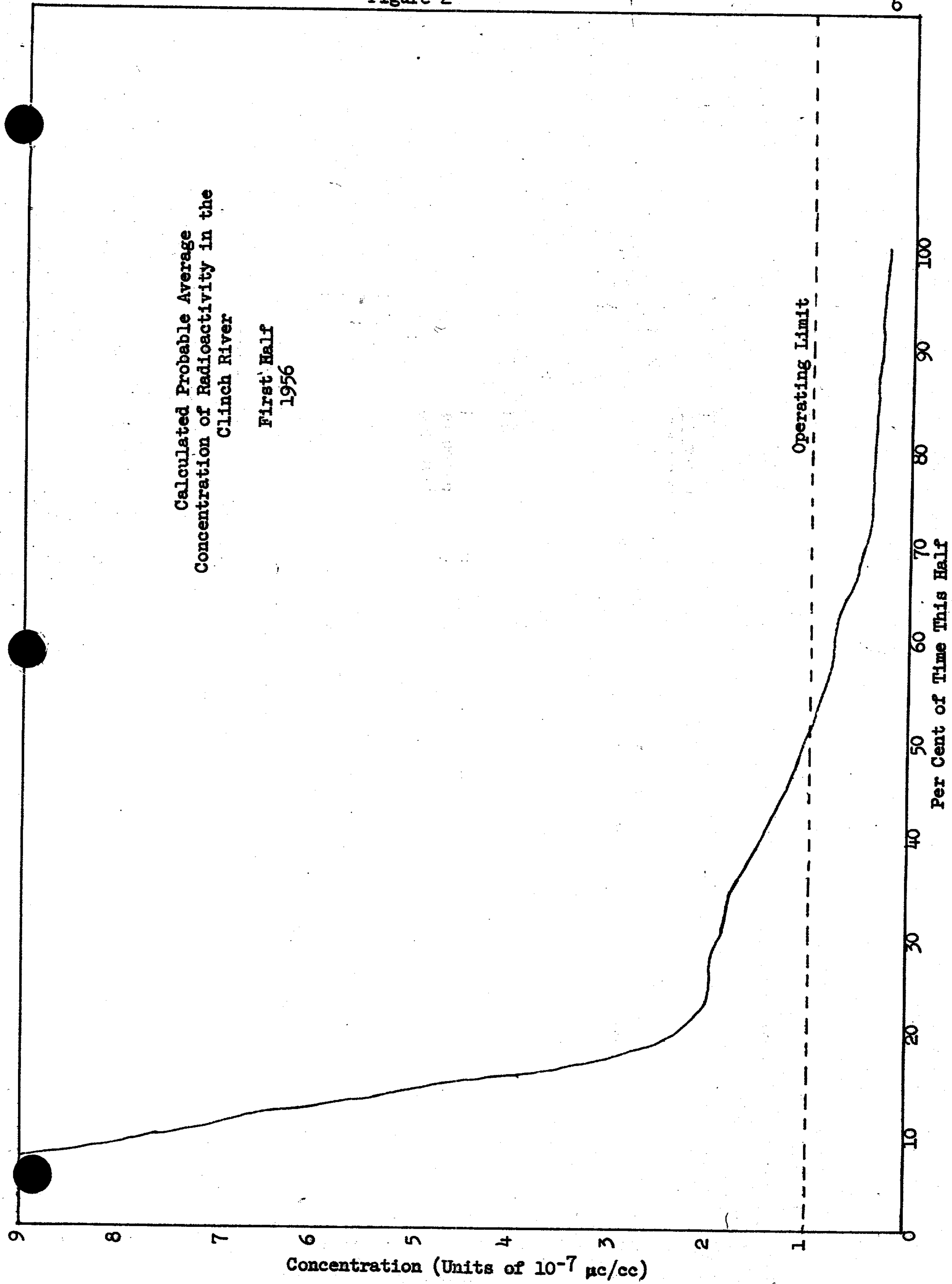

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Figure 3

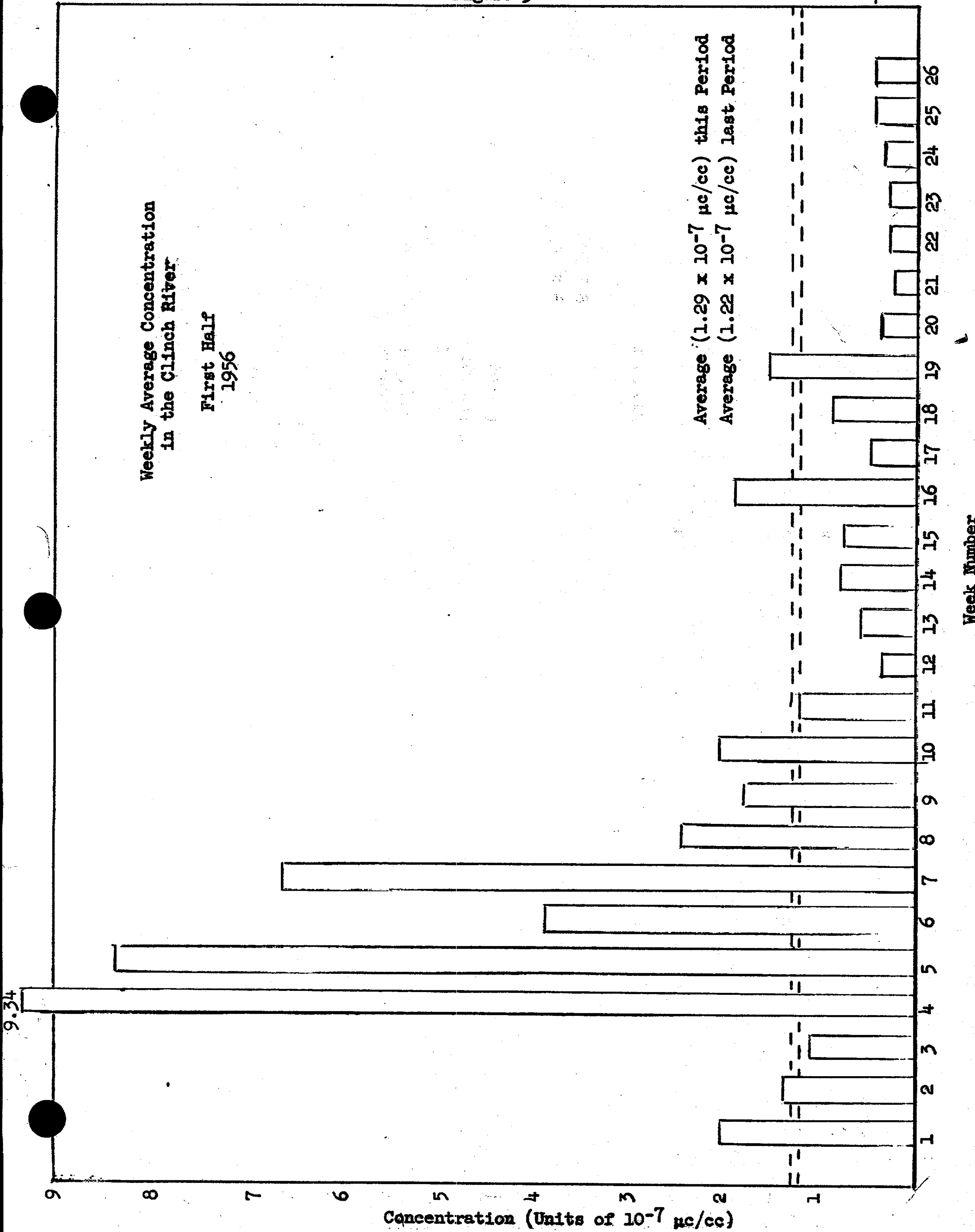

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Figure 4

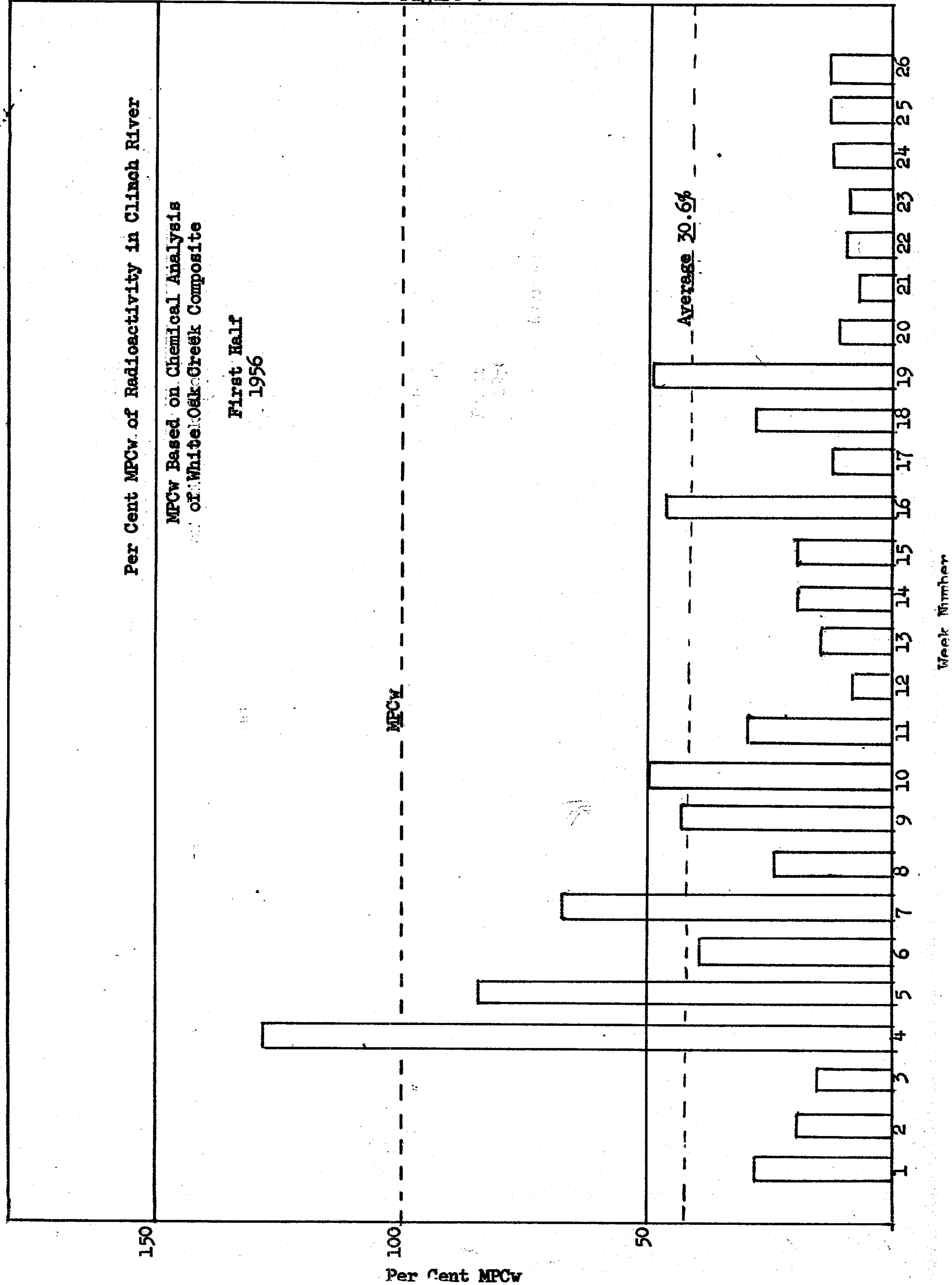

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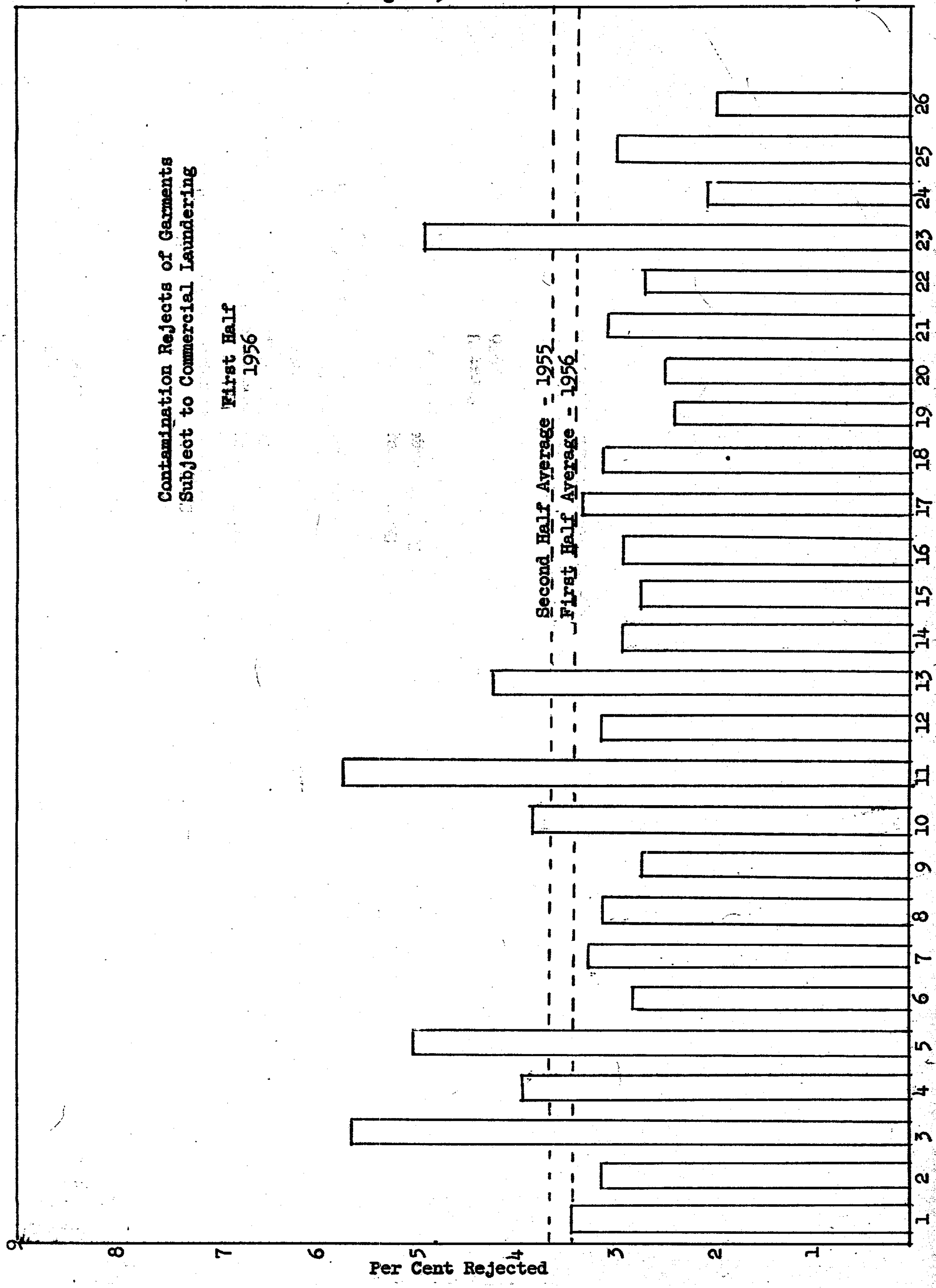
Figure 5



SECTION II. ASSAYS - INSTRUMENTS

Part A. Salient and Non-Routine Items

Preliminary reports have been prepared as follows:

1) Energy Response of the ORNL "Slotted" Cutie Pie Chamber
2) Supplementary Information on Dosage Determination with Film
3) Recovery of Multi-ton Quantities of Contaminated Scrap Metal
4) Personnel Exposures in Planes Carrying Radioisotopes

Completed design for and began procurement and assembly of special air sampling instrumentation for ART.

P. E. Brown participated from March 12 through June 24 at the Pacific Proving Grounds as a consultant to the NRDL Health Physics Group.

Tritium fluid analysis equipment has been installed in Building 2008.

Part B. Statistical Data

1. Assays and Measurements Unit

a. Counting Services - (Weekly Average)

Type of Sample and Requestor	Calculations Required or Points Plotted	No. Counts Performed Alpha	No. Counts Performed Beta	Units Per Count*	Total Unit
Smears		2561	2820	1	5383.0
Air Samples	197	225	227	3	1947.0
Area Monitoring		8.3	28	4	145.0
ERDL			0.7	4	2.6
Decay and Absorption Studies	10.8	6.1	44.6	4	307.5
St. Louis Iron Works		1.1		4	4.4
Applied Radiobiology (Urinalysis Research)	6.6(gamma)	0.5	3.7	4	43.2
Sanitary Engineering			25.7	4	103.0
Health Division (Nasal Smears)			1.6	4	6.4

Average Units Per Week this Report	7942.1
Deviation of Weekly Average this Report from 1955 Weekly Average	- 6.1%
Total Units Handled to Date this Year	206,494
Deviation of Weekly Average to Date this Year from 1955 Weekly Average	- 6.1%

* Unit = 2/3 min.

b. Chemical Analysis

Chemical Analysis	Weekly Average
Pu (X-10 & K-25)	12.9
U	22.5
Sr	16.2
Gross Alpha	0.4
Ra	.1
Gross Beta	1.5
Tritium	0.1
Mixed Fission Products	0.7
Cerium	0.1
Americium	0.1
Protoactinium	0.3
Polonium	0.1
Thorium	2.1
Lead (Urine)	2.5
(Blood)	0.9
(Blanks)	1.2
(Air)	0.1
Average number of samples per week	61.8
Deviation of weekly average this report from 1955 weekly average	- 2.2%
Total samples handled to date this year	1607
Deviation of weekly average to date this year from 1955 weekly average	- 2.2%

2. Calibration Unit

a. Film Routine

Average number of films calibrated per week	268
Deviation of the weekly average this report from 1955 weekly average	+ 21%
Total films calibrated	6965
Deviation of weekly average to date this year from 1955 weekly average	+ 21%

b. Instrument Routine

Average number of instruments calibrated per week	93
Deviation of the weekly average this report from 1955 weekly average	+ 4%
Total instruments calibrated	2408
Deviation of weekly average to date this year from weekly average of 1955	.4%

3. Portable Instruments Repaired

a. Average number of instruments repaired per week	49
b. Deviation of the weekly average this report from weekly average of 1955	+ 2%
c. Total instruments repaired to date this year	1268
d. Deviation of weekly average to date this year from weekly average of 1955	+ 2%

4. Operation of Fixed and Semi-Portable Instruments*

	1	2	3	4	5	6
a. Constant Air Monitors	8190	1817	6373	46	78%	.6%
b. Monitrons	9828	926	8902	166	91%	1.7%
c. Hand & Foot Counters	1386	185	1201	11	87%	.8%

1. Total number of "Instrument Days" where an "Instrument Day" is defined as the number of instruments times the number of work days in the quarter.
2. Number of "Instrument Days" for which operational reports were received.
3. Number of "Instrument Days" for which operations reports were not received.
4. "Instrument Days" instrument reported out of service.
5. Per cent of "Instrument Days" not reported.
6. Per cent of "Instrument Days" instrument reported out of service.

4. (Cont'd) Operation of Fixed and Semi-Portable Instruments

	1	2	3	4	5	6
d. AC Poppies (Alpha & Beta-Gamma)	2898	195	2703	0	93%	0%
e. Scalers (including Alpha Counters)	3528	620	2908	28	82%	.8%
f. Precipitrons	1764	472	1292	1	73%	.06%
g. Friskers	1386	80	1306	0	94%	0%
h. Filtrons	1260	24	1236	0	98%	0%
i. Disc Air Samplers	1890	536	1354	18	72%	.95%

SECTION III. PERSONNEL MONITORING

Part A. Salient and Non-Routine Items

During February and March 1956, a group of ten employees was assigned on a temporary basis to compile cumulative exposure data on all Laboratory personnel.

Four cases of significant exposure in the first half of 1956 were identified as diagnostic X-ray.

Part B. Statistical Data

1. Personnel Meters

a. Distribution and Performance of Pocket Meters

	Weekly Av. to Date This Year	Deviation of this year's av. from 1955 weekly Average
Meters Distributed	3426	- 17.4%
Readable Meters	3425	- 17.4%
Non-Readable Meters	1	- 66.6%
Non-Readable Pairs	0	0
Off-Scale Readings	12	- 07.7%
Off-Scale Pairs	1.23	- 13.4%

b. Expected Off-Scale pocket Meter Pairs .10

c. Distribution and Processing Data of Film Meters

West Portal	2338	+ 13.1%
East Portal	1250	+ .5%
Visitors	700	- 05.5%
Ring Films, Packets, etc.	123	- 24.1%
Routine Neutron Films	328	+ 32.3%
Special Neutron Films	2	- 98.1%
Calibrations	200	+ 04.7%
Correspondents	59	- 49.1%
Special X-ray Films	0	-100.0%
Total Films Handled	5000	+ 02.3%

d. Film Meter Data Loss

	Weekly Av. to Date This Year	Deviation of this Year's Av. from 1955 Weekly Average
Badge meters not serviced	68	- 17.7%
Films lost	0	0
Films damaged	0	0
Total	68	- 17.7%

2. Investigations Initiated

a. From Pocket Meter Records

Significant total of 300 mr (ep) or more	.02	+1450.0%
Off-Scale Pairs	1.40	- 26.4%
Non-Readable Pairs	.02	- 100.0%
Total	1.44	- 06.9%

b. From Film Meter Records

Weekly PTR of 1000 mrep or more, or shield of 600 mr or more	4	- 51.0%
Questionable PTR of 1000 or more	.60	+ 01.6%
Lost or damaged films	.10	+ 20.0%
Average >100% or MPE/wk.	5.88	- 72.4%
Total	10.44	- 58.7%

c. Investigation Results

	Investigated to Date This Year	Confirmed to Date This Year
Pocket Meters	29	13
Film Meters	111	23
Total	140	36

Paired off-scale pocket meters investigated to date this year	29
Legitimate number of off-scale pocket meter pairs to date this year	13
Statistical probability of spurious (paired off-scale) pocket meter readings to date this year	.8

Fig. 6 [redacted]

ORNL-LR-Dwg. -16253

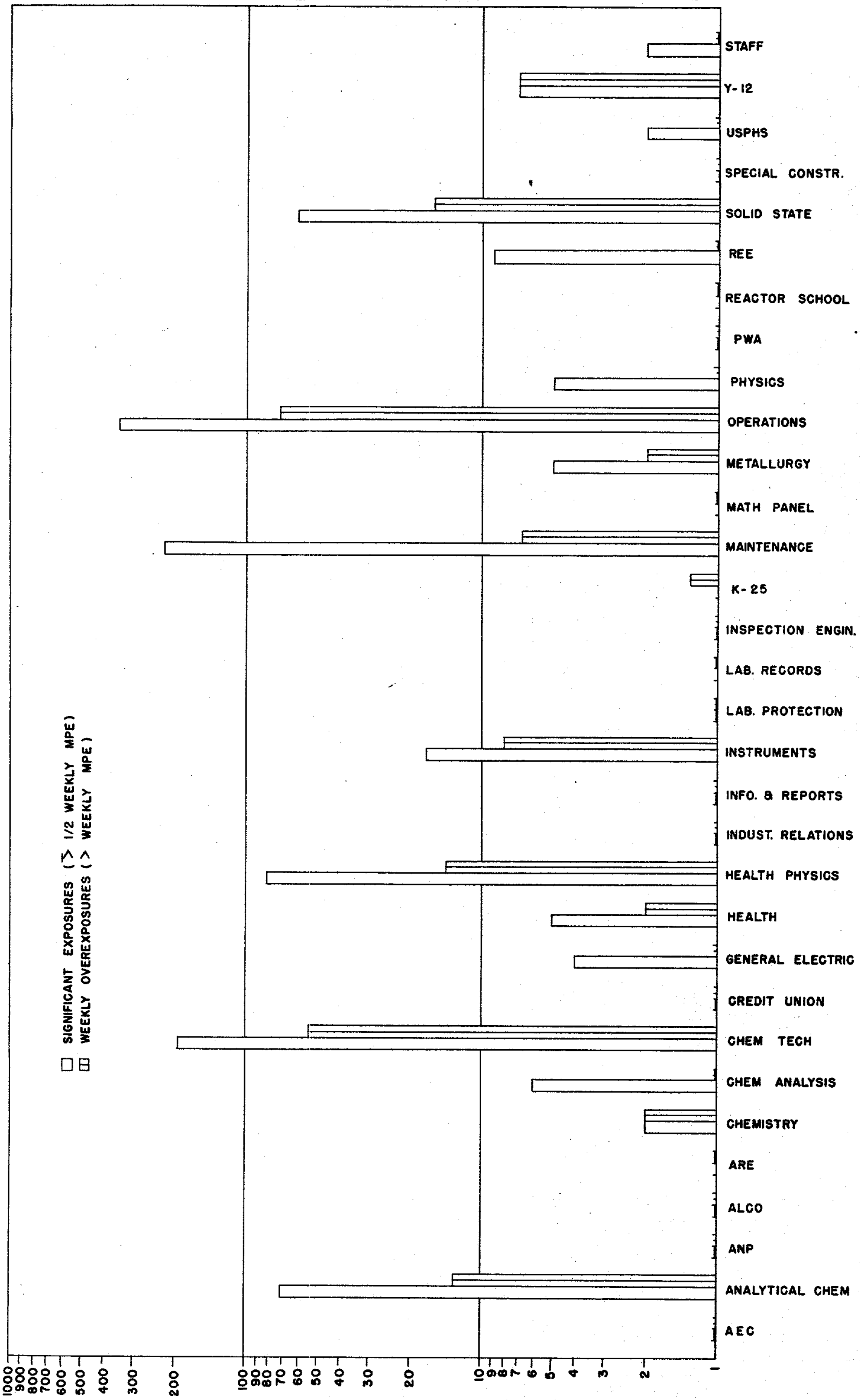


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Fig. 7 ORNL-LR-Dwg.-16254

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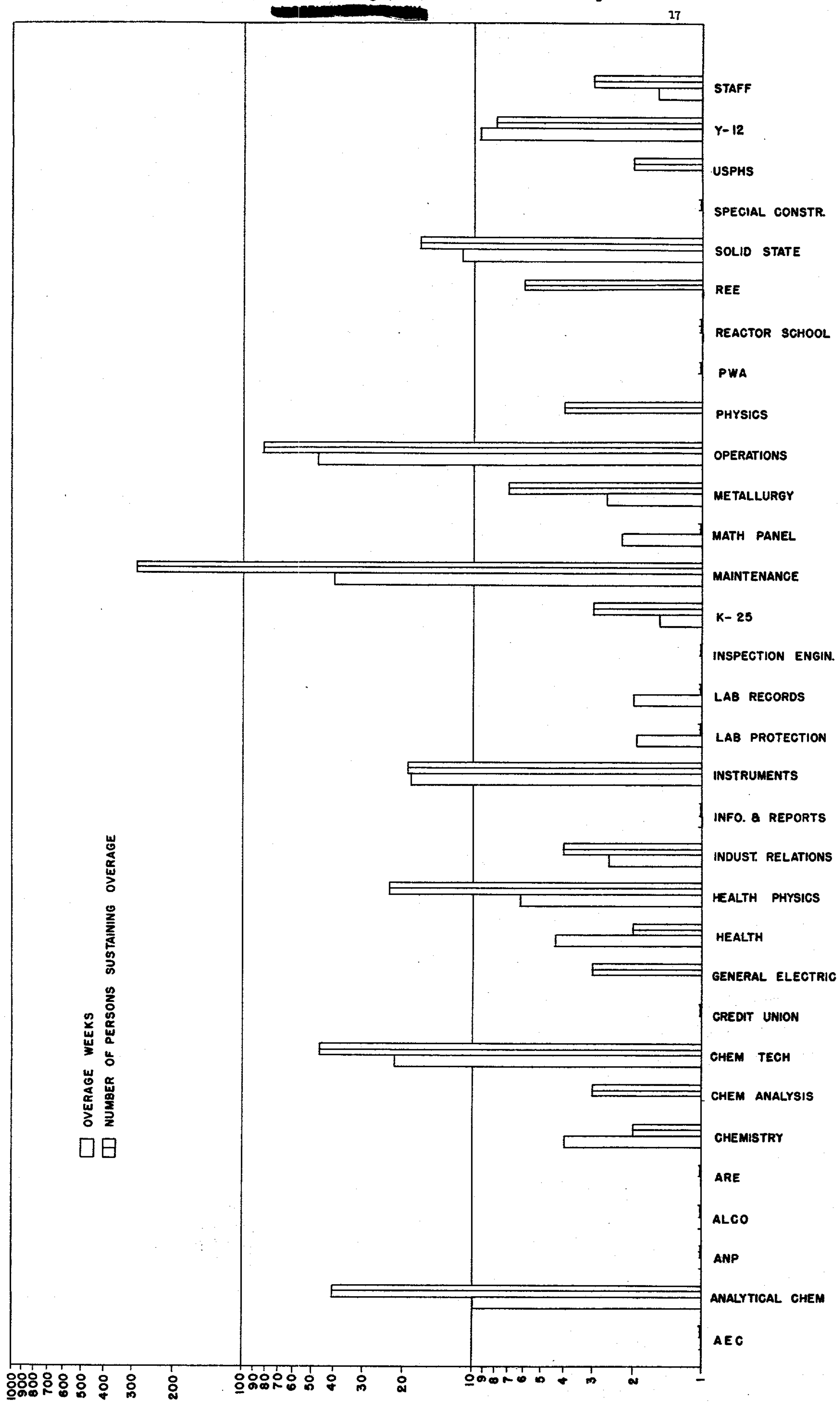

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SECTION IV. RADIATION SURVEY

Part A. Salient and Non-Routine Items

Applied Health Physics field training for the AEC Fellowship Students started June 11 and will be completed by August 30.

One member of the Radiation Survey Group was away from the Laboratory on special assignment with NRDL from May 16 through August 3.

General Research, Chemistry, and Operations Surveys

Approximately 20 ml of radioactive material was spilled in Room 209, Building 3019 on January 26, resulting in contamination to floor surfaces as well as slight personnel contamination of two employees. Ref: "Spill in Room 209, Building 3019", dated January 27, 1956.

On February 2, 1956, a leak was detected at the steam line in the northeast corner of the M-room in Building 3505. A fan-shaped area extending three feet from the line was contaminated with fission products. The concrete beneath the line was chipped out and the floor resurfaced. Ref: "Leak in Steam Line in Room M, Building 3505", dated February 10, 1956.

An employee fell in the canal at Building 3505 (Metal Recovery Building) on March 1, 1956. He was immersed in the canal water up to his waist. After a shower no contamination was detectable on his person. Ref: "Radiation Incident Report on Canal Operation at Building 3505" dated March 1, 1956.

On May 18, three samples containing radioactive material were delivered to the Analytical Chemistry Laboratory in Building 3019 for dissolving. While attempting to dissolve the sample, some of the material blew out of the hood contaminating the floor. By May 20 a general clean-up had been accomplished. Ref: "Pu Incident May 18 to May 20, 1956 in Building 3019", dated May 25, 1956.

Reactors, Accelerators, and Related Physics Surveys

The semi-annual autoradiographic survey of the Graphite Reactor site was completed during January. Forty films used in this study gave no significant change in particulate build-up or distribution as compared with previous film surveys.

Circulation of the cooling water to the experimental facility at Hole 17-N in the Graphite Reactor was interrupted on April 4. This brought on partial melting of the paraffin shield which created a fast neutron hazard in that area of 40 times the permissible rate for weekly exposure. The reactor was shut down and paraffin placed in front of the hole. No significant exposure to personnel occurred during the incident.

ORNL, Y-12 Facilities

On February 1, a large excess reactivity was introduced in one of the experimental critical assemblies in Building 9213. Details concerning the incident may be obtained from a report by L. C. Johnson to J. C. Hart. Subject: "Radiation Excursion in Building 9213", dated August 10, 1956.

SECTION V. TECHNOLOGICAL STUDIES

During the first half of 1956, approximately half the effort of this section was applied directly to consideration of various aspects of reactor hazards. These included further studies of the Oak Ridge Research Reactor and a study for the Safeguards Report of the problems arising from the contemplated enriched loading of the graphite reactor.

An invited paper on the air pollution aspects of power reactors was prepared and given at an engineering conference at the University of Florida. Work was completed on a general study of reactor hazards versus power level.

Included in varied technical assistance on a number of Health Physics problems of the Division and of the Laboratory were studies of the Fission Product Production Plant site contamination. An earlier study of the comparative hazards of radium isotopes was brought up to date for use in internal dose studies. Discussions with visitors chiefly concerned potential hazards arising from the operation of reactors for which they were responsible.

J. C. Hart, Chief
Applied Health Physics

Data Compiled by: A. D. Warden
D. M. Davis
J. C. Ledbetter
T. J. Burnett
H. H Abee
et., al.

JCH:mfm

[redacted]

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SUBJECT: APPLIED HEALTH PHYSICS QUARTERLY REPORT
January thru March 1961

TO: K. Z. Morgan

FROM: J. C. Hart

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61-5-100

[redacted]

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

Date: May 10, 1961

Subject: APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY THROUGH MARCH, 1961

To: K. Z. Morgan

From: J. C. Hart

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H. F. McDuffie
A. J. Miller
M. L. Nelson
A. R. Olsen
J. J. Pinajian
M. E. Ramsey
M. L. Randolph
L. P. Riordan
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A. H. Snell
W. S. Snyder
W. M. Stanley
E. H. Taylor
O. D. Teague
A. D. Warden
M. K. Wilkinson
C. E. Winters
Laboratory Records

[redacted]

UCN-430
(3 11-60)

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY THROUGH MARCH, 1961

J. C. Hart, Section Chief

DATA CONTRIBUTED BY:

H. H. Abee	L. C. Johnson
R. L. Clark	J. C. Ledbetter
D. M. Davis	O. D. Teague
E. D. Gupton	A. D. Warden

CONTENTS

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1.0 INTRODUCTION

It has been the practice for the past several years to summarize health physics monitoring data as required on a daily, weekly, monthly, quarterly, or annual basis. In general, the formal summary has been developed annually as an ORNL report for off-site distribution. Following the radiation safety training courses, there has been an increase in the number of requests for health physics data. As a result, it seems appropriate that a brief summary of the monitoring data be issued more frequently than annually to include a general distribution to the Laboratory divisions. There will be no change in the reporting of data to operating groups where information is needed on a daily, weekly, and/or monthly basis. Likewise, the detailed annual summary will continue to be issued for off-site distribution.

2.0 SUMMARY

2.1 Area Monitoring

Figures 1 and 1A show the average background reading as measured at approximately 50 stations on the Laboratory and five off-area stations. The average background on the Laboratory has remained essentially constant since 1954 with the exception of the year 1959 during which unusual incidents involving considerable contamination occurred.

Figures 2 and 2A show the radioactivity measurements in the Clinch River in terms of percent maximum permissible concentration $(MPC)_w$. Figure 2 gives the average per month for the past twelve months. Figure 2A gives the average per year since 1954. The peaks occurring in the last twelve months (November, January, and February) were due primarily to the loss in dilution in the Clinch River resulting from periodic curtailment of water releases at Norris Dam.

Figures 3 and 3A present average air-borne radioactivity measurements for ten local stations and eight remote stations located at TVA dam sites. Figure 3 presents data for the past twelve months and Figure 3A is a plot of yearly average data from 1950 through 1960. The average value for 1960 was approximately a factor of 10 less than the value for 1959. This drop was due largely to the curtailment of Laboratory operations during the first half of 1960 and the installation of more efficient cleaning equipment for off-gas streams.

Figures 4 through 5A show the number of particles collected and the ten local and eight remote stations in terms of average number of particles per square foot and average number of particles per 1000 cubic feet of air sampled. In general, the average number of radioactive particles

[redacted]

in the air has been decreasing over the last four years. Although the average for 1960 was considerably lower than the average for 1959, there was a noticeable peak in November of 1960 which probably can be attributed to defective filters in the off-gas systems.

Figure 6 presents the activity range of the radioactive particles in terms of the percent of the particles, with a total activity of $> 10^5$ dis/24 hrs. This graph serves to emphasize that most of the particles are $< 10^5$ dis/24 hrs.

Results from first quarter sampling indicate little change in average radioactivity background reading and radioactivity in the Clinch River. The average number of particles collected, both gummed paper samples and filter type samples, decreased during this quarter.

2.2 Personnel Monitoring

Figure 7 presents the number of persons per month whose pocket meter readings exceeded an average of 100 mr per week, based on pocket meter data of a type which does not require the processing of the film badge meter. The three peaks occurring in September, February and March were due primarily to continued decontamination and removal of radioactive components from cells in Building 3019 and from maintenance work on the HRT system, particularly during the month of March. Most of the exposure was accumulated in background levels of 5 to 50 mr/hr.

No employee received an exposure in excess of permissible values during the first quarter of 1961.

2.3 Assays-Instruments

Figure 8 shows the number of employees per month who submitted one urine specimen > 100% E.I. (Excretion Index = $q\frac{0.693}{T_b}\ 2.2 \times 10^6$) or three consecutive specimens > 25% E.I.

The number of employees who submitted one urine specimen > 100% E.I. or three consecutive specimens > 25% E.I. decreased considerably over the number for the last six months of 1960.

One specimen > 100% or three consecutive specimens > 25% E.I. is normally the basis for temporary removal of an employee from potential exposure. An employee whose work assignment is changed for these reasons is returned to his normal work when two later consecutive samples show activity < 25% E.I.

2.4 Radiation Surveys

During the first quarter of 1961 there were fifteen unusual occurrences. These occurrences are listed by title and date in Table 1, "Unusual Occurrences During the First Quarter of 1961". None of these occurrences were classified as major events.

3.0 STATISTICAL RESUME

3.1 Area Monitoring

Fig. 1	Average Radioactivity Background Reading (Months)
Fig. 1A	Average Radioactivity Background Reading (Years)
Fig. 2	Radioactivity Measurements in the Clinch River (Months)
Fig. 2A	Radioactivity Measurements in the Clinch River (Years)
Fig. 3	Air-Borne Radioactivity Measurements (Months)
Fig. 3A	Air-Borne Radioactivity Measurements (Years)
Fig. 4	Air-Borne Radioactive Particles (Months)
Fig. 4A	Air-Borne Radioactive Particles (Years)
Fig. 5	Radioactive Particles Collected on Gummed Paper Trays (Months)
Fig. 5A	Radioactive Particles Collected on Gummed Paper Trays (Years)
Fig. 6	Activity Range of Particles Collected On-Site by Gummed Paper

3.2 Personnel Monitoring

Fig. 7	Number of Persons Whose Pocket Meters Exceeded an Average of 100 mr/wk

3.3 Assays-Instruments

Fig. 8	Number of Employees Who Submitted One Urine Specimen > 100% E.I. (Excretion Index) or Three Consecutive Specimens > 25% E.I.

3.4 Radiation Surveys

Table 1	Unusual Occurrences During the First Quarter of 1961

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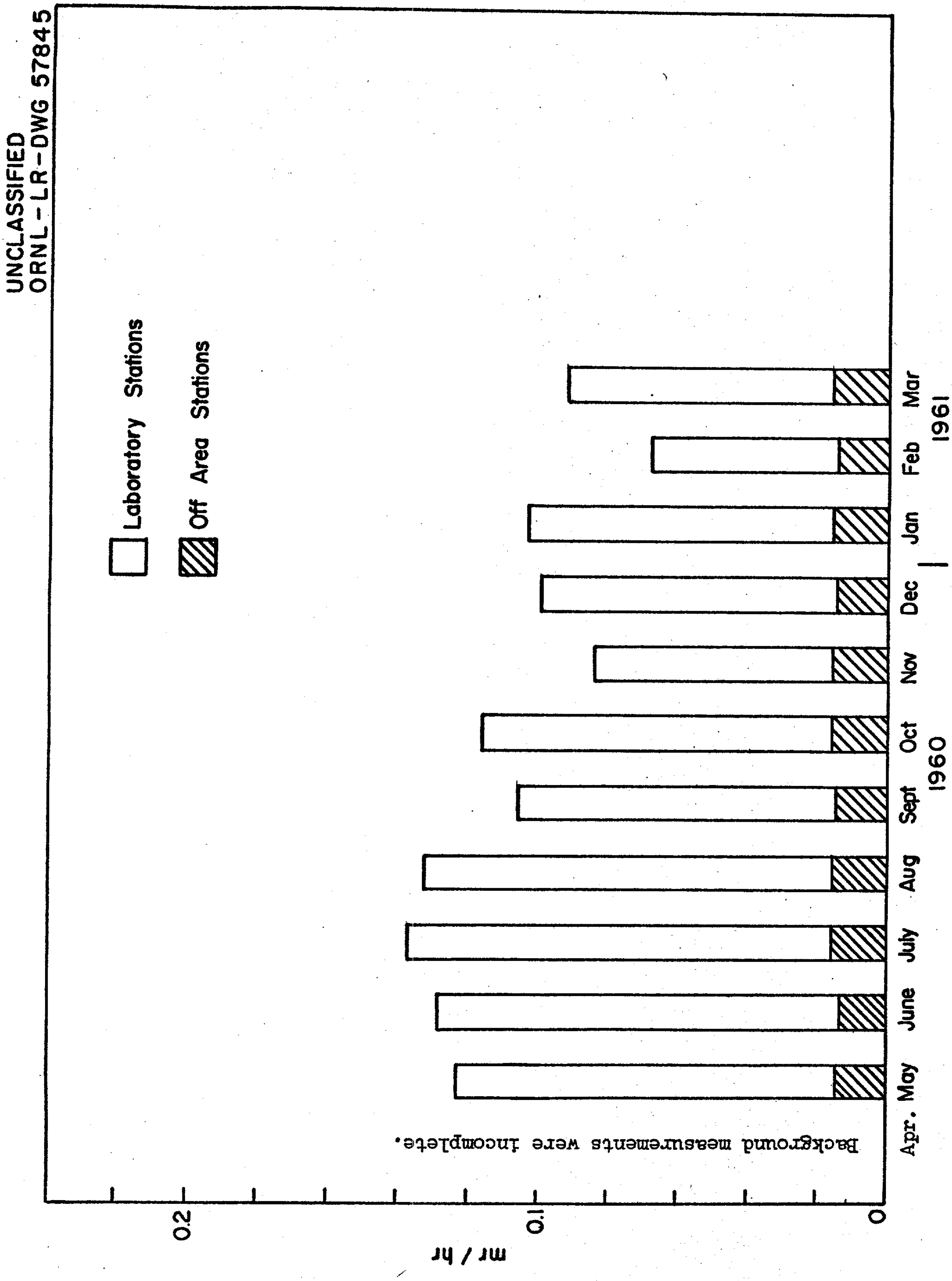

Fig. I. Average Radioactivity Background Reading

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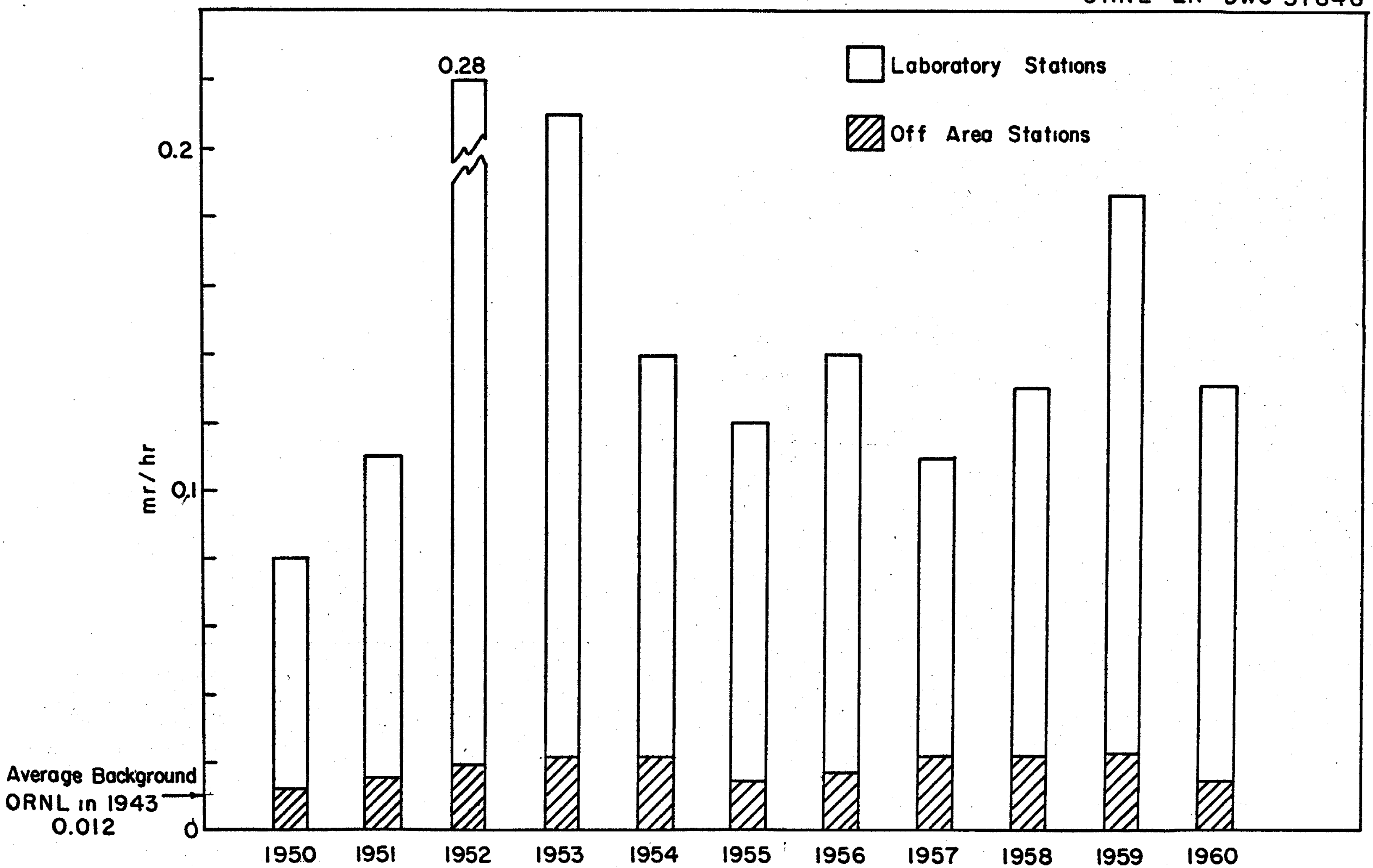

Fig. 1A Average Radioactivity Background Reading

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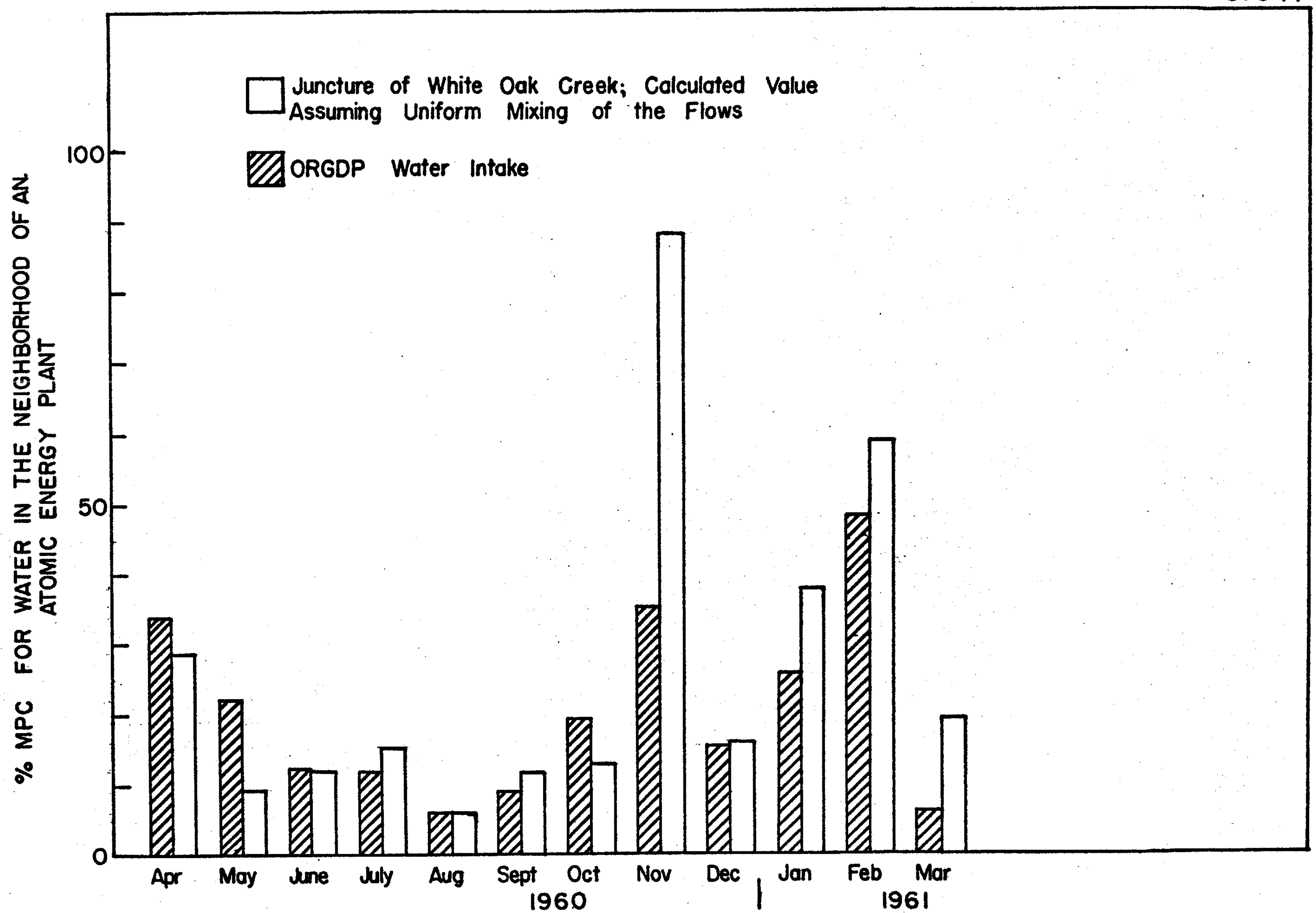

Fig. 2. Radioactivity Measurements in the Clinch River

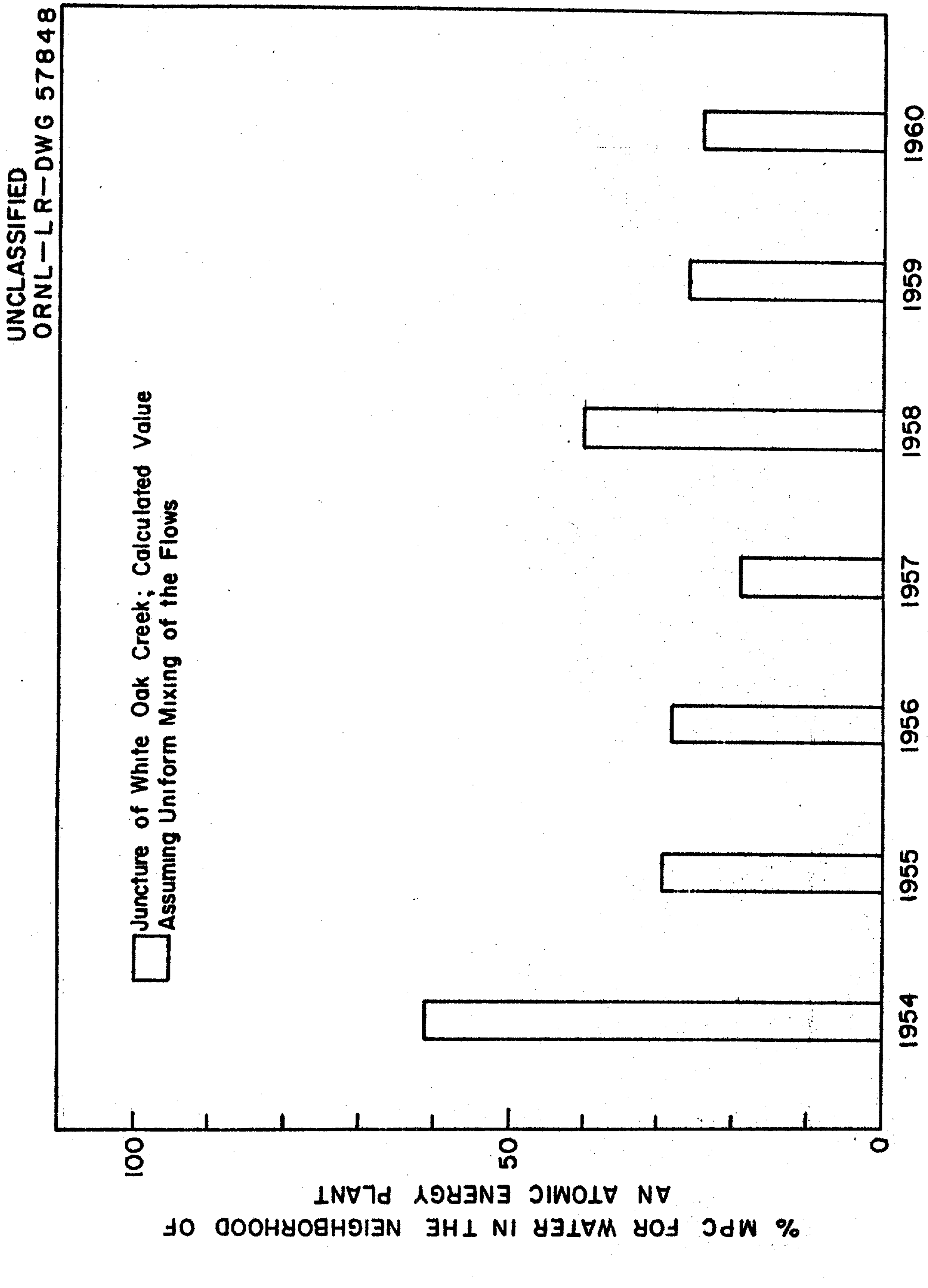

Fig. 2A Radioactivity Measurements in the Clinch River

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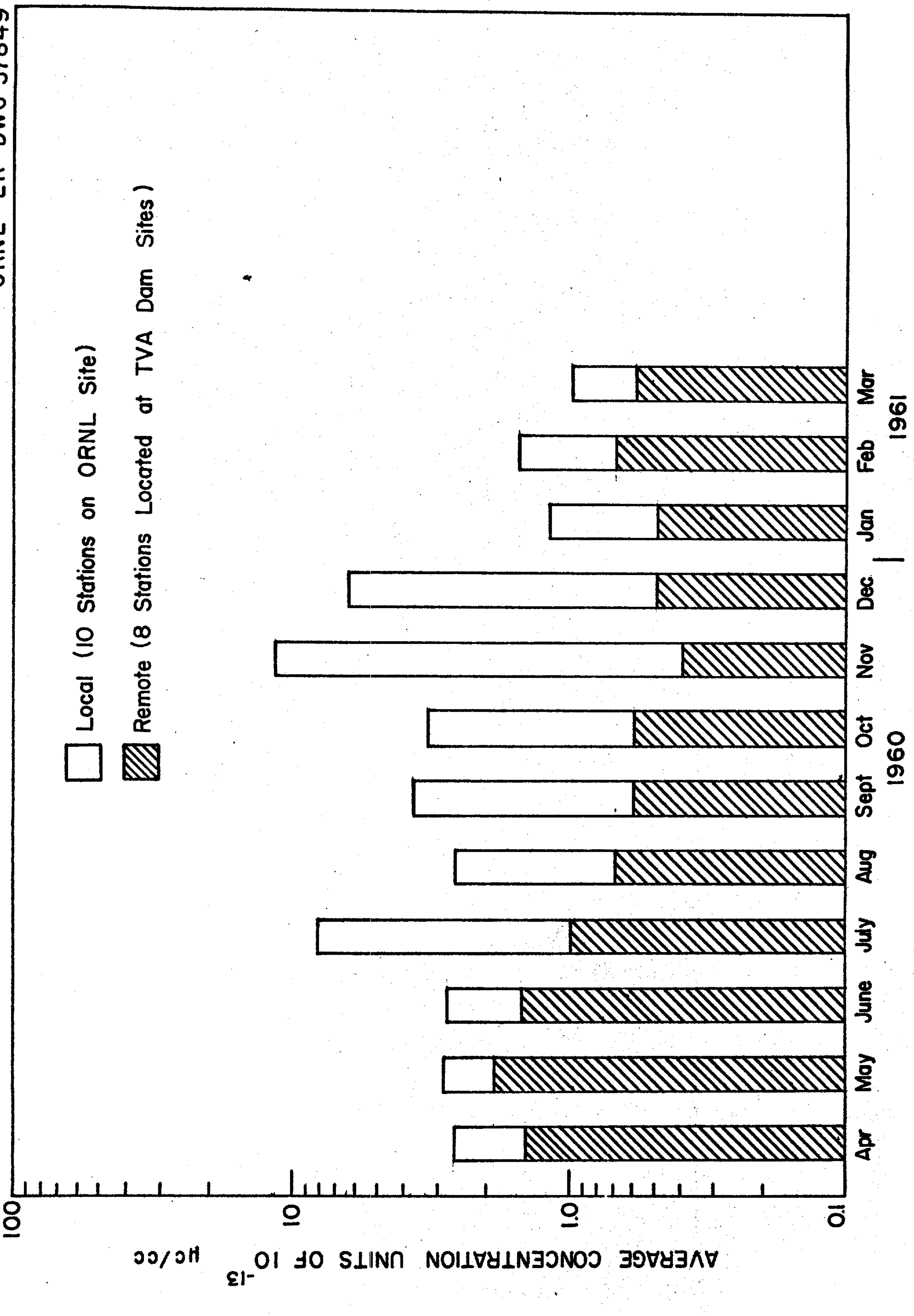

Fig. 3. Airborne Radioactivity Measurements

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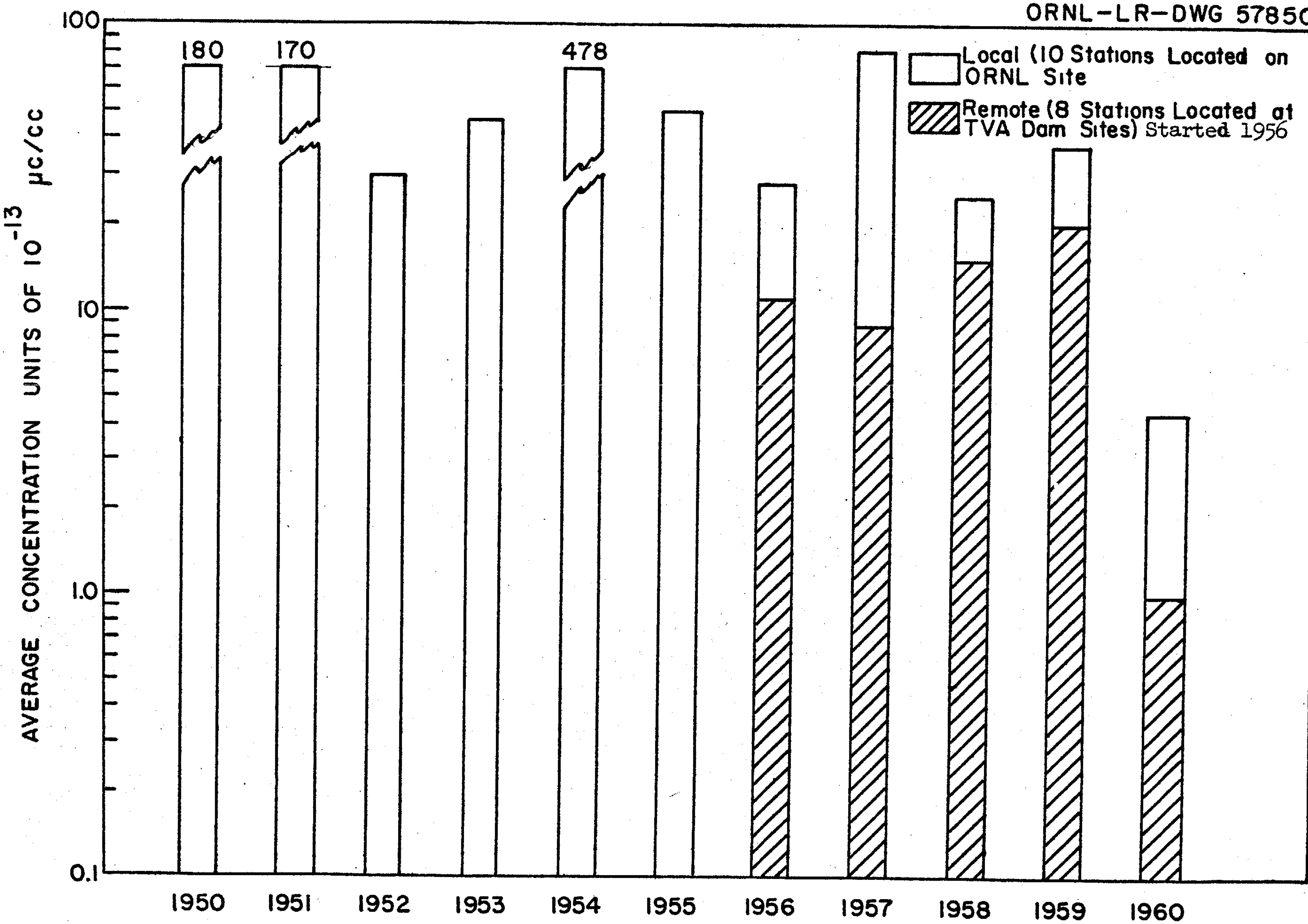

Fig. 3A Airborne Radioactivity Measurements

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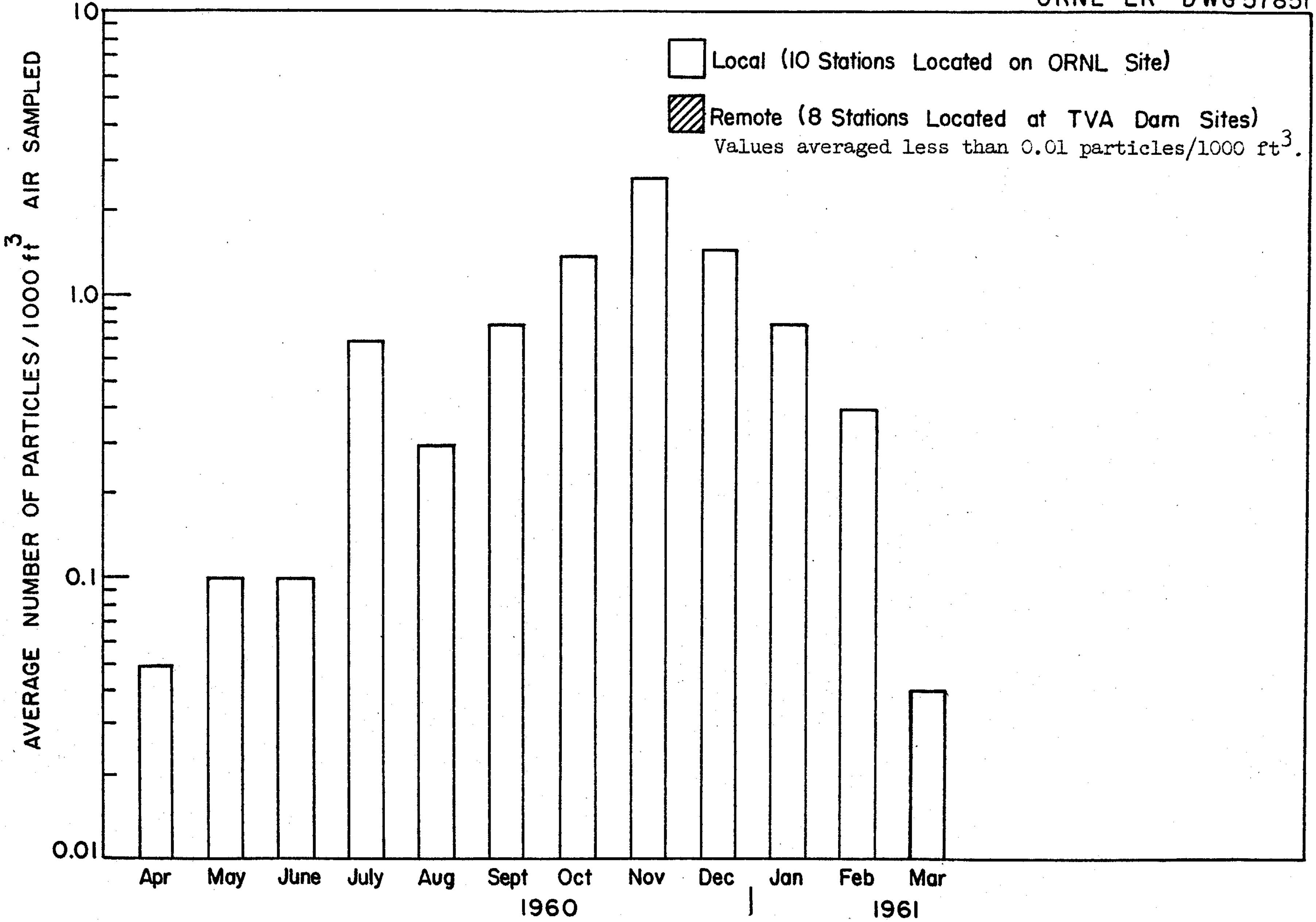

Fig. 4. Airborne Radioactive Particles

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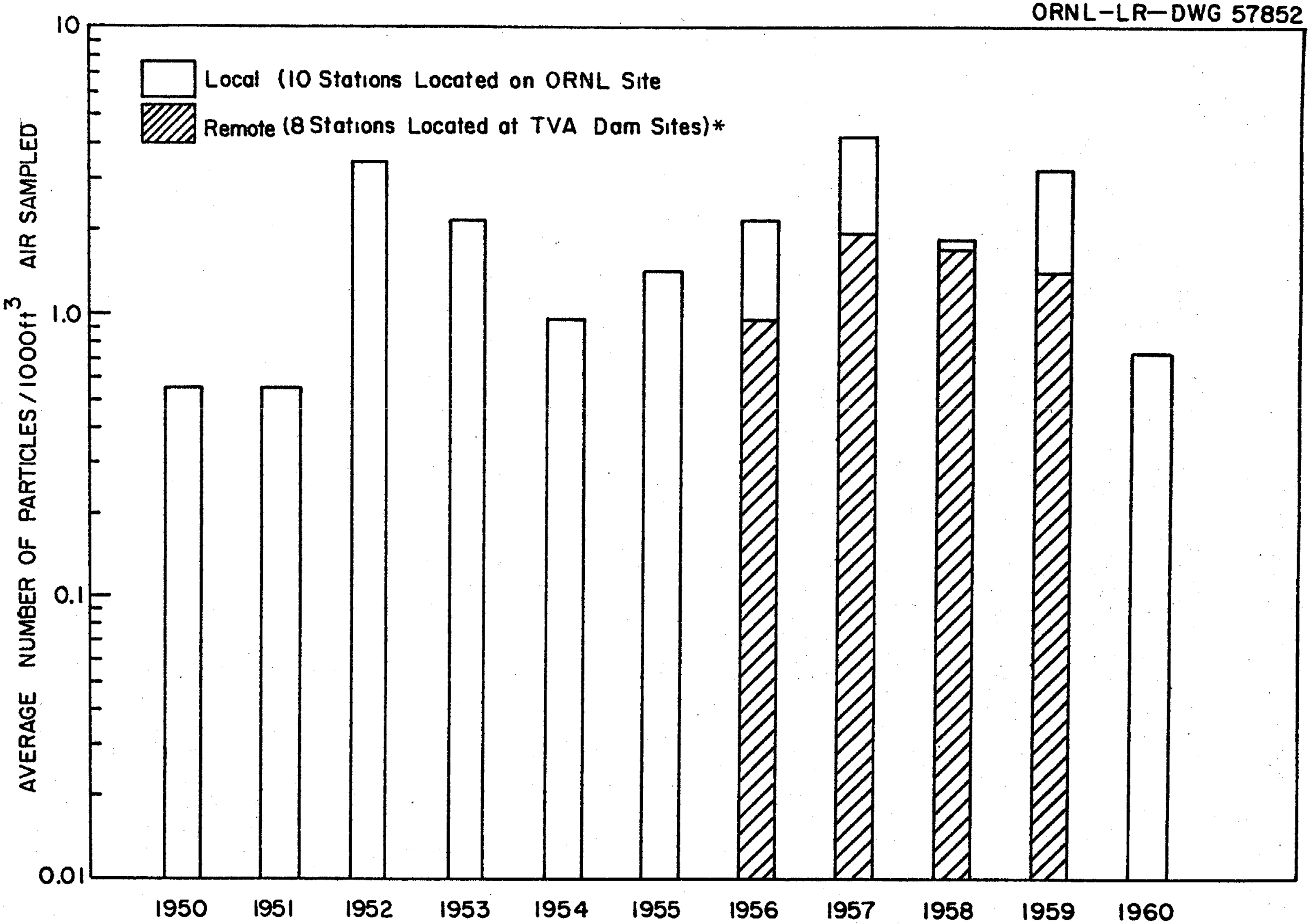

Fig. 4A Airborne Radioactive Particles

* Stations started in 1956. The average number of particles/1000 ft^3 in 1960 was less than 0.01.

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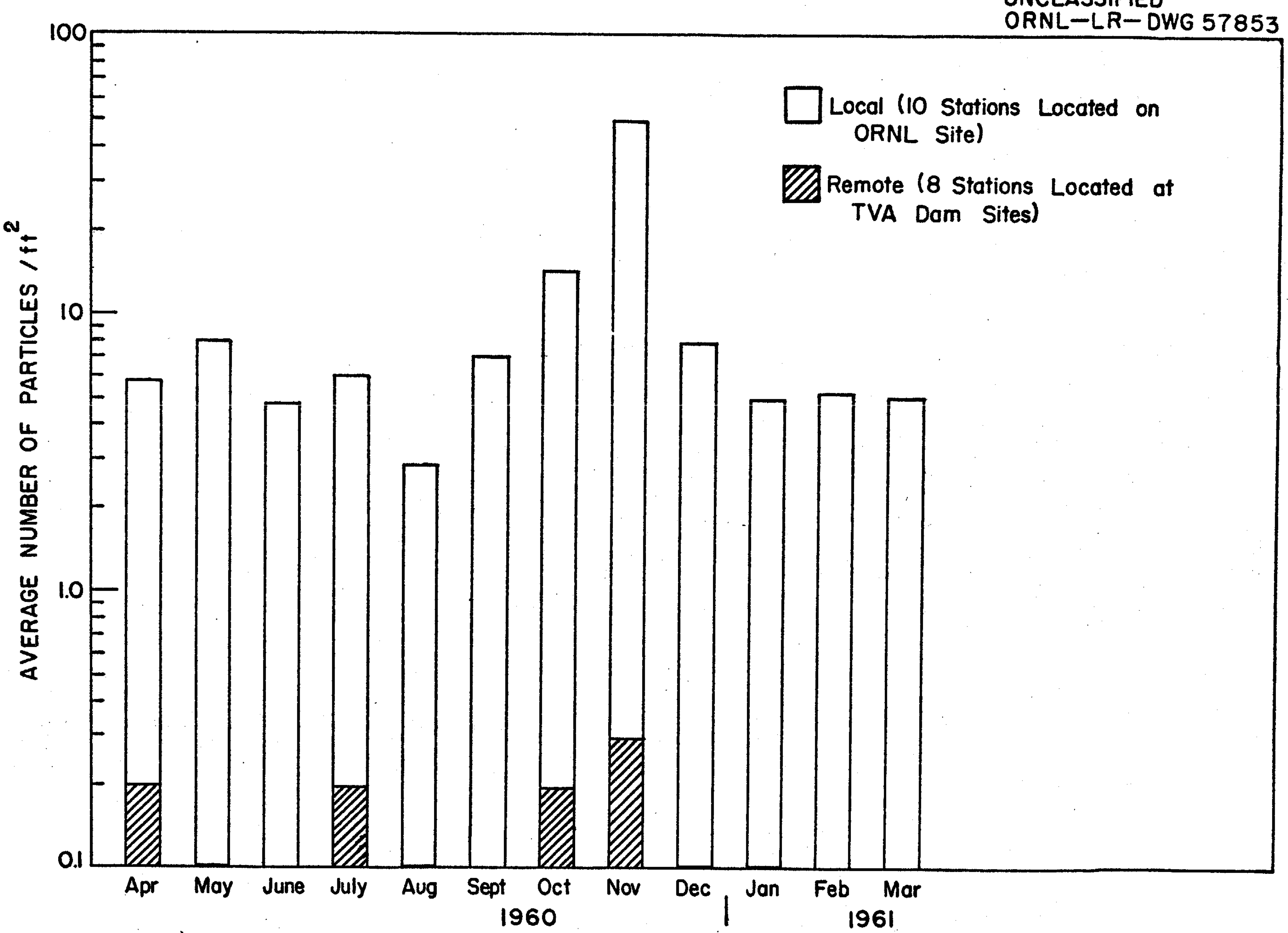

Fig. 5. Radioactive Particles Collected on Gummed Paper Trays

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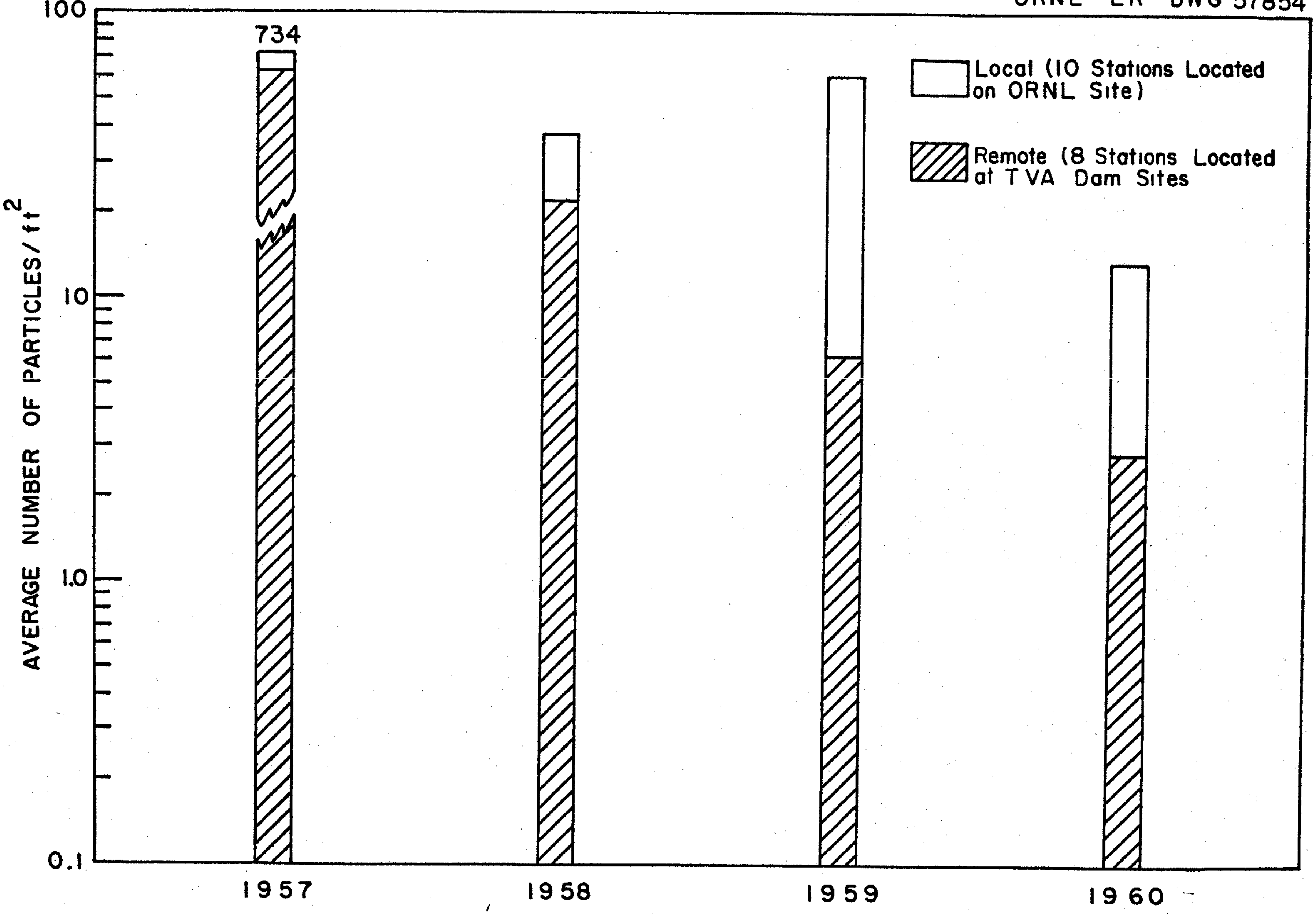

Fig. 5A Radioactive Particles Collected on Gummed Paper Trays

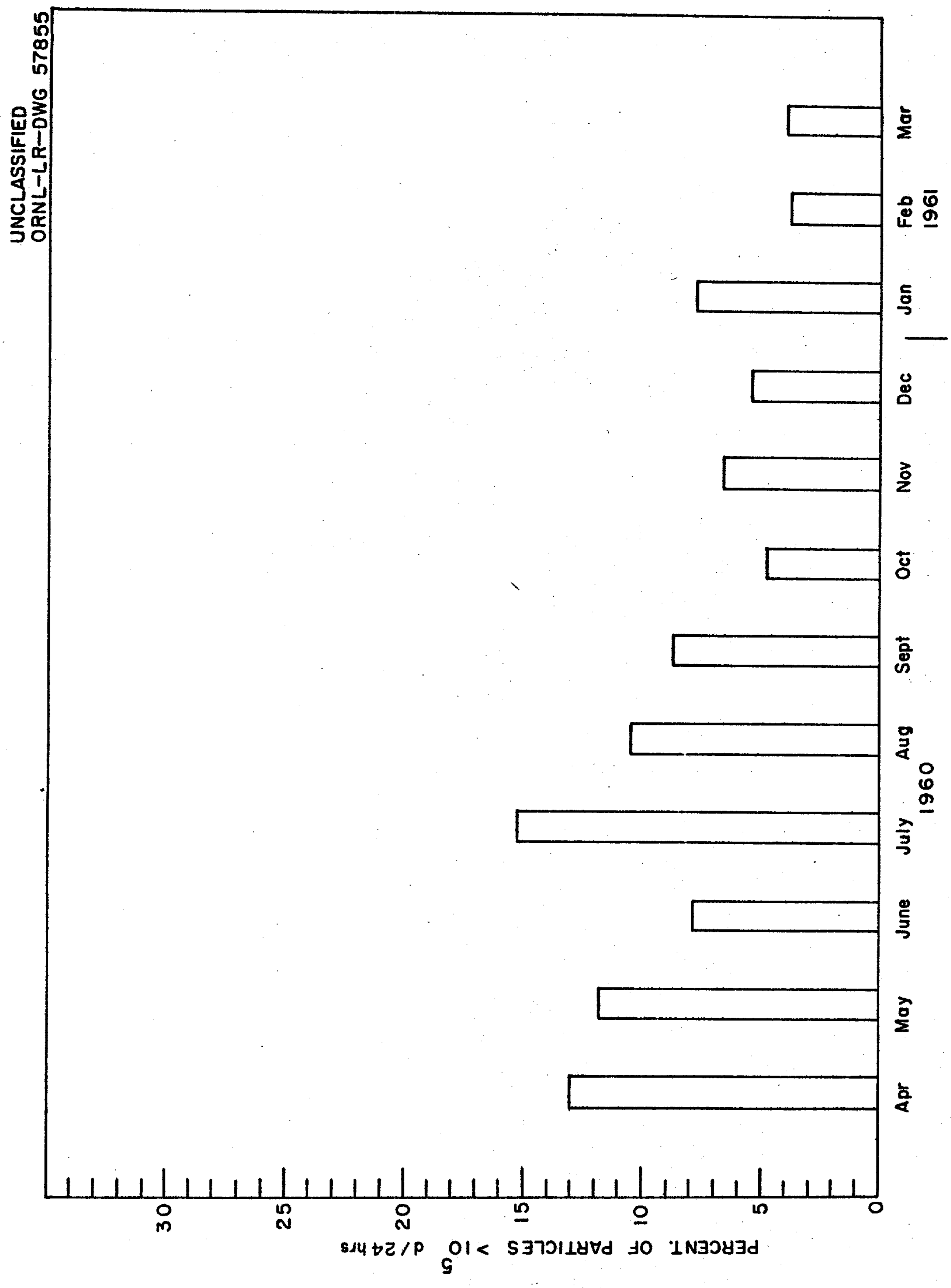

Fig. 6 Activity Range of Particles Collected on Site By Gummed Paper

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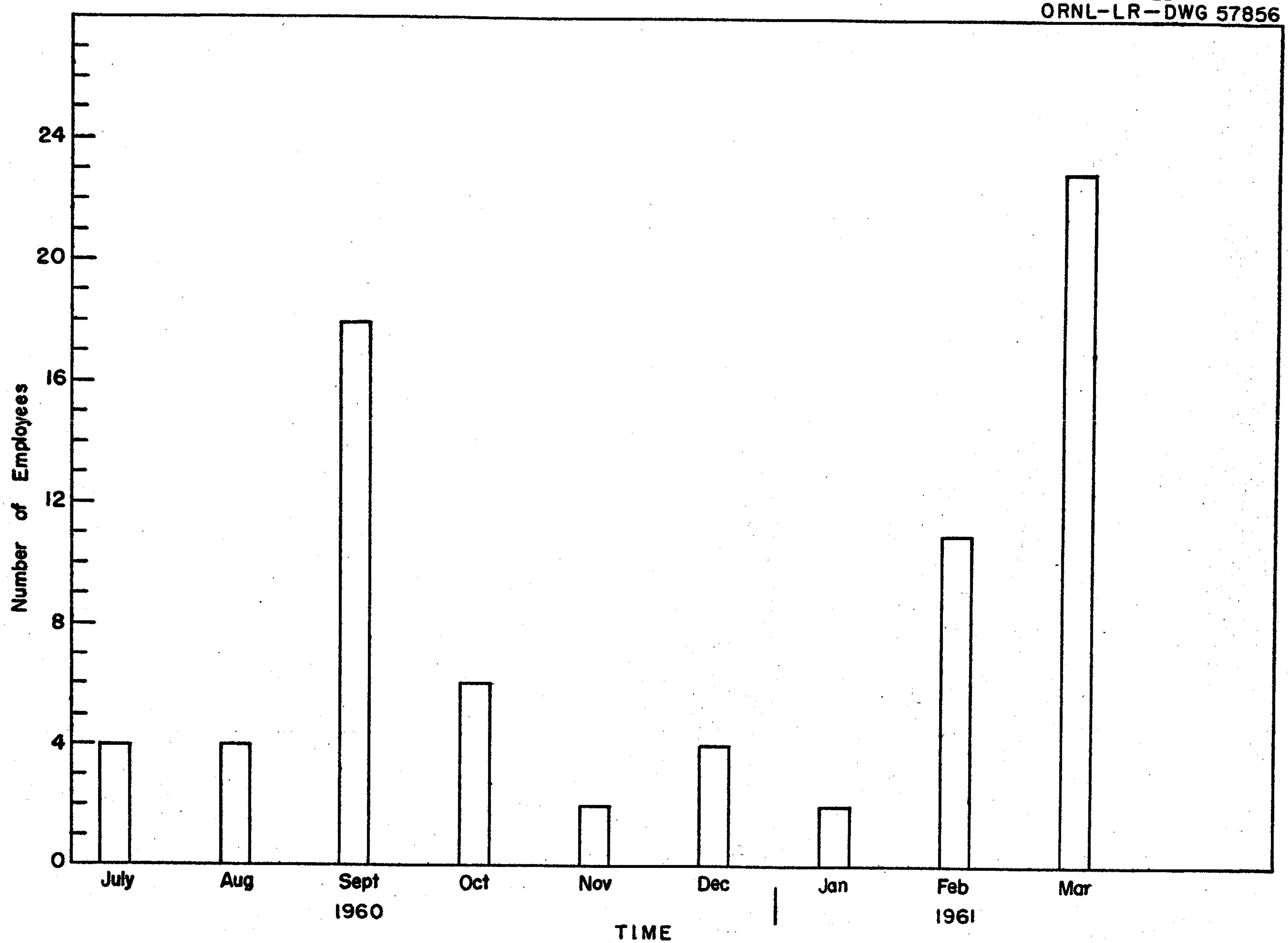

Fig. 7 Number of Persons Whose Pocket Meter Readings Exceeded an Average of 100 mr per Week, Based on Pocket Meter Data of a Type Which Does Not Require the Processing of the Film Badge Meter

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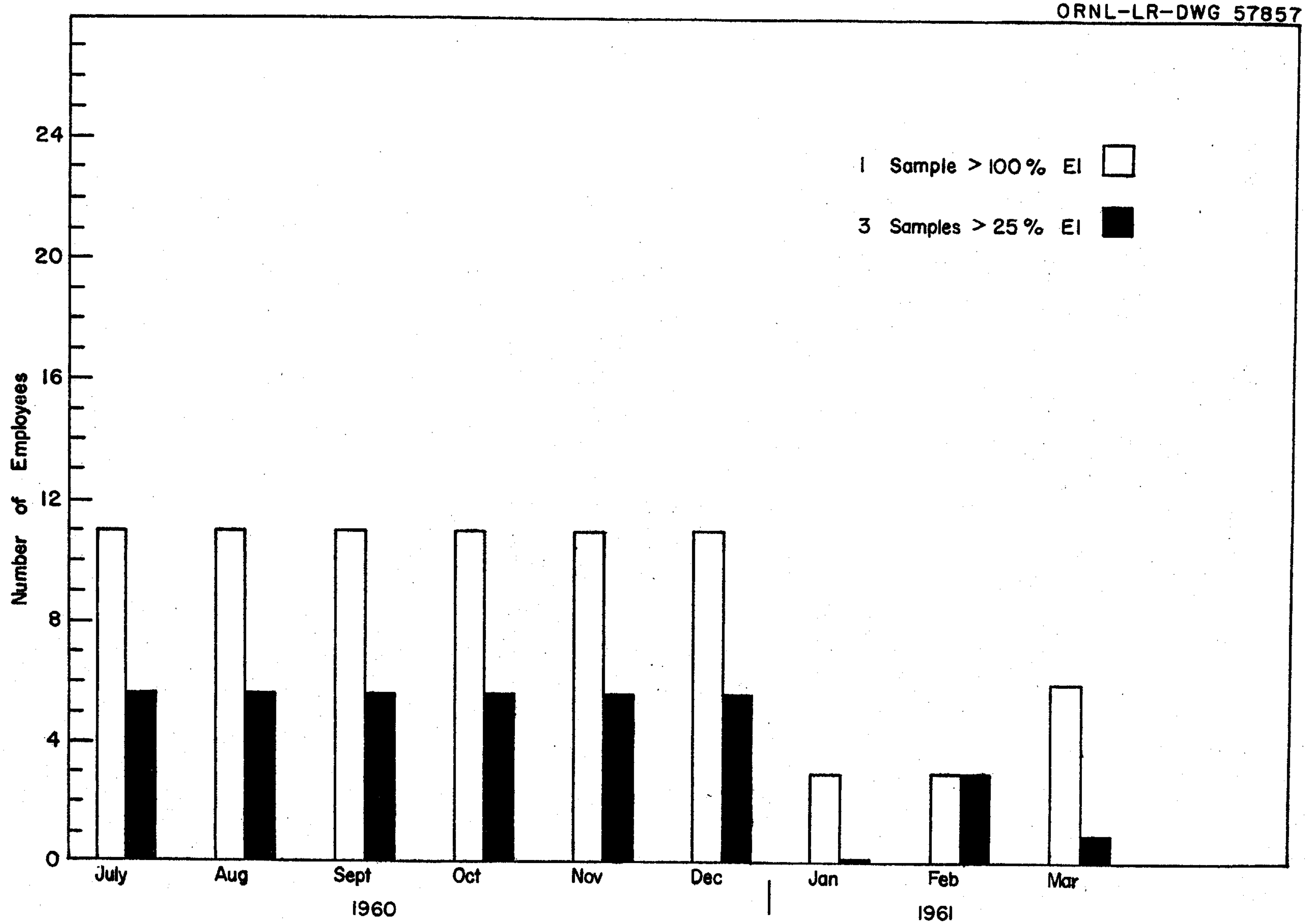

Fig. 8. Number of Employees Who Submitted One Urine Specimen > 100 % EI (Excretion Index) or Three Consecutive Specimens > 25 % EI. July—Dec Average for Six Months. (Data not available for individual months.)

Table 1. UNUSUAL OCCURRENCES DURING THE FIRST QUARTER OF 1961

JANUARY

1. Incident in Cells 6 and 7, Personnel Contamination, Building 3019 1/6/61.
2. Puncture Wound Received in Penthouse, Building 3019 (HPP) - 1/17/61.
3. Contamination Spread from Fuel Sample Carrier, Buildings 7500 (HRT) and 3019 (HRLAF) - 1/19/61.

FEBRUARY

1. Personnel Contamination, Cells 6 and 7, Building 3019 - 2/2/61.
2. Unusual Contamination Occurrence in Buildings 2005 and 2024 Involving Carbon-14 - 2/7/61.
3. Clothing Requirement Violation and Contamination Incident, Building 3019 - 2/13/61.
4. Investigation of Off-Scale Pocket Meters Received in Cell 5, Building 3019 - 2/13/61.
5. Rupture of Ce-133 Target at 86" Cyclotron, Building 9201-3, Y-12 - 2/21/61.

MARCH

1. Contamination Incident in Room 219 of Building 4501 - 3/1/61.
2. Contaminated Wound Received at Building 7500 (HRT) - 3/2/61.
3. Ruptured Target at 86" Cyclotron, Building 9201-2, Y-12 - 3/3/61.
4. Ruptured Target at 86" Cyclotron, Building 9201-2, Y-12 - 3/5/61.
5. Contamination Incident in Lab 8, Building 3026-C - 3/2/61.
6. Area Contamination, Building 7500 (HRT) - 3/11/61.
7. Air Activity, Building 7500 (HRT) - 3/27/61.

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75-81. Laboratory Records

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This document has been approved for release to the public by:

David R Hamrin 5/21/96
Technical Information Officer   Date
ORNL Site

[redacted]

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - APRIL THROUGH JUNE, 1961

J. C. Hart, Section Chief

DATA CONTRIBUTED BY:

H. H. Abee
T. J. Burnett
R. L. Clark
D. M. Davis
E. D. Gupton
L. C. Johnson
J. C. Ledbetter
O. D. Teague
A. D. Warden

Table of Contents

1.0 SUMMARY

There were no reportable radiation incidents[1] during the quarter although one radiation exposure occurred which exceeded the maximum permissible exposure level permitted to the hand and forearm. All except one of the 22 unusual occurrences experienced during the quarter were categorized as minor events. There were no major increases in the radioactivity in the waste effluents; radiation background readings indicated only normal variations.

1.1 Unusual Occurrences

Twenty-two unusual occurrences were recorded during the second quarter as listed by title and date in Table 1. Fourteen of these events involved the contamination of personnel, Laboratory surface areas, or both. In addition, there was one fire, two puncture wounds potentially involving contamination, and five instances where air contamination was the primary source of interest. One of the 14 events involved significant personnel exposure (see Section 1.2 below) and is classified as a major event since a laboratory operational limit was exceeded by a considerable margin. The criteria for distinguishing between the minor and major event have been previously established.[2]

1.2 Personnel Monitoring Resume

The only employee receiving an exposure in excess of permissible limits during the second quarter of 1961 involved a hand exposure sustained while the employee was performing a product transfer operation.

[1] Atomic Energy Commission Manual, Chapter OR-0523, "Radiation Exposure Reports".

[2] See ORNL 3073, p. 4, Section D.

The dose to the forefinger and thumb of the right hand was estimated to be about 330 rem. No clinical effects were observed and no detectable internal exposure occurred. The whole body penetrating dose was ~65 mrem.

As a partial index of the external exposure status of employees performing day-to-day routine operations involving radioactive materials, Figure 1 presents the number of persons per month whose pocket meter readings for that month averaged greater than 100 mrem per week.[3] The data in Figure 1 are not significantly at variance with those for the preceding nine months.

Figure 2 shows the number of employees per month who submitted one urine specimen >100% EI, or three consecutive specimens >25% EI.[4] The values for 1960 shown in Figure 2 represent the average for the period during the time the majority of cases related to the 3019 clean-up operation. The lower values for June 1961 may have been due to the fact that fewer samples were processed as the result of the relocation

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3 These are persons who, for at least a month, have had a sustained exposure rate which is greater than 100 mrem per week. An exposure rate of 100 mrem per week is significant since, if continued, it produces the limiting accumulated dose to the whole body of 5(N-18) rem to age N years. The system further provides that cumulative pocket meter readings accrued during a quarter in excess of 1000 mrem and/or off scale pocket meter readings (>200 mrem) require the processing of the film badge meter. In all instances where film badge meters are processed for the above two reasons the results are supplied to the health physics area representative for evaluation and subsequent review by supervision.

4 EI is Excretion Index $= q \dfrac{0.693}{T_b} 2.2 \times 10^6$ (in d/m/day),

where q = Maximum Permissible Body Burden of isotope having an elimination half life of T_b days. One specimen of ≥100% EI, or three consecutive specimens of >25% EI, is normally taken as a basis for considering temporary removal of an employee from further potential exposure. An employee whose work assignment is changed for these reasons is returned to his normal work when two later consecutive samples show the EI to be less than 25%.

of the bio-assay laboratory. During the second quarter two individuals were removed temporarily from their regular work assignment on the basis of an elevated EI determination.

An administrative procedure is currently being studied by the Internal Dose Section for the purpose of establishing a routine to allow for "adjustments" in the radiation dose status of employees who are subjected to both external and internal radiation exposure. In this regard the ICRP[5] has recommended as follows:

> "The radiation doses delivered to the appropriate organs or tissues should be calculated and noted on the personal record, and the permitted doses of external radiation should be adjusted to allow for the 'internal' doses."

The ICRP statement has been interpreted to mean that an increase in the body burden of certain radioisotopes above some arbitrary value (say above 30%) is of sufficient significance to consider the limiting of external exposures to a point below the otherwise permissible occupational external exposure rates.

1.3 Environmental Monitoring

Figures 3A and 3B show the average gamma background reading as measured at approximately 50 stations at or near the Laboratory site and five off-area stations. The average background recorded at these stations during the second quarter of 1961 appears to be relatively stable.

Figures 4A and 4B show values for the Clinch River in terms of the per cent of the maximum permissible concentration. The monthly averages

[5] Recommendations of the International Commission on Radiological Protection (Adopted September 8, 1958), Pergamon Press, p. 18.

(Figure 4A) show the usual fluctuation pattern varying in most cases with high or low river flow. Although the per cent $(MPC)_w$ for the first half of 1961 shows a slight increase over the level recorded for 1960, (Figure 4B), the pattern shown for the past six years seems to be relatively stable.

Figures 5A and 5B show measurements representing air-borne radioactive constituents for eight remote stations located from 12 to 120 miles from ORNL and ten local stations. The second quarter values deviate from previous report periods only within normal statistical ranges. No significant general exposure contribution is indicated (either for Laboratory or off-site personnel) as the concentrations continue to average less than one per cent of the $(MPC)_a$ as specified in Handbook 69.

Figures 6A through 7B show the number of particles collected at the ten local and eight remote stations in terms of the average number of particles per square foot of surface area and the average number of particles per 1000 cubic feet of air sampled. No significant personnel exposure is indicated and the cessation of weapons testing appears to continue to play an important part in the reduction of the number of particles collected at the remote stations.

The per cent abundance of radioactive particles showing a total activity of $>10^5$ dis/24 hrs. is shown in Figure 8. There is no immediate explanation for the low values recorded for the month of May or the somewhat greater values recorded for the month of June. It is clear that most of the particles collected are less than 10^5 dis/24 hrs. However, as the distribution of particle sizes is not known, the data are not directly related to any biological hazard index.

2.0 TABLES AND GRAPHS

Table 1. UNUSUAL OCCURRENCE REPORTS BY TITLE FOR THE SECOND QUARTER OF 1961

APRIL

1. Radioactive Material Spill, (Tc-99) Lab. D-29, Bldg. 4500 - 4/4/61
2. Personnel Contamination, (U-233) Bldg. 3019 (HPP) - 4/3/61
3. Personnel and Room 127 Contamination (FP, Pa-233) Bldg. 4501 - 4/5/61
4. Transient Air Contamination (Xe, Kr) Bldg. 3005 (LITR) - 4/11/61
5. Surface Contamination (S-35) Bldg. 9207, Room 307-A - 4/12/61
6. Potential Puncture Wound Contamination (Pu-239) Bldg. 3019 Penthouse - 4/12/61
7. Radiation and Contamination Incident at Fission Products Development Laboratory (Sr-90) Bldg. 3517 (F3P) - 4/14/61
8. Surface Contamination (U-238) East Pad, Bldg. 3503 - 4/18/61
9. Personnel and Area Contamination (Am-241) Bldg. 3508, Lab 2 - 4/25/61
10. Contamination Incident and Zoning Procedure Violation (Pu-239) Bldg. 3505 - 4/25/61

MAY

1. Air Activity (A-41 from B-9 Experiment) Bldg. 3042 (ORR) - 5/3/61
2. Air Activity (Kr-85) Bldg. 3517 (F3P) Cell 14 - 5/17/61
3. Air Activity (I-132) Bldg. 7500 (HRT) Storage Pool - 5/17/61
4. Alpha Air Contamination (U-235) Bldg. 3019 (HPP) Cell 2 - 5/19/61
5. Personnel Contamination (U-233) Bldg. 3019 (HPP) Cell 2 - 5/22/61

JUNE

1. ORR South Hot Cell Fire (NaK) Bldg. 3042 - 6/1/61
2. Personnel Contamination (U-233) Bldg. 3019 (HPP) - 6/2/61
3. Personnel Contamination (F.P.) Bldg. 7500 (HRT) - 6/2/61
4. Soil Contamination (F.P.) at Pipe Tie, 4508 Construction Area (New Ceramics Bldg.) - 6/13/61
5. Ruptured Target Contamination (Cs-132) 86" Cyclotron, Bldg. 9201-2 (Y-12) - 6/16/61
6. Puncture Wound (no contamination) Bldg. 3022 - 6/21/61
7. Personnel Contamination (Cs-137, Co-60) Ditch SE of Bldg. 3019 (HPP) - 6/21/61

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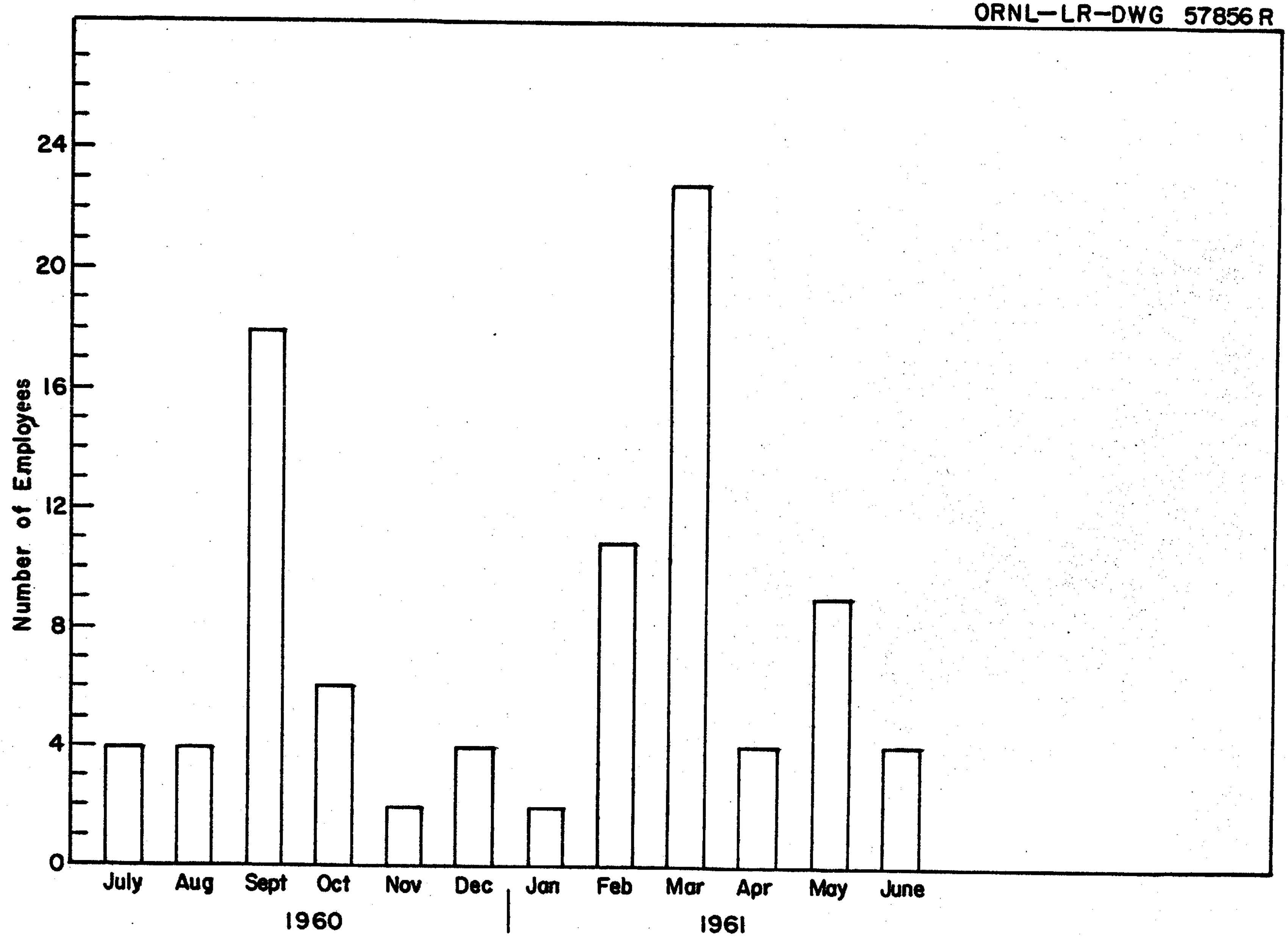

Fig 1 Number of Persons Whose Pocket Meter Readings Exceeded an Average of 100 mrem Per Week During The Month Indicated

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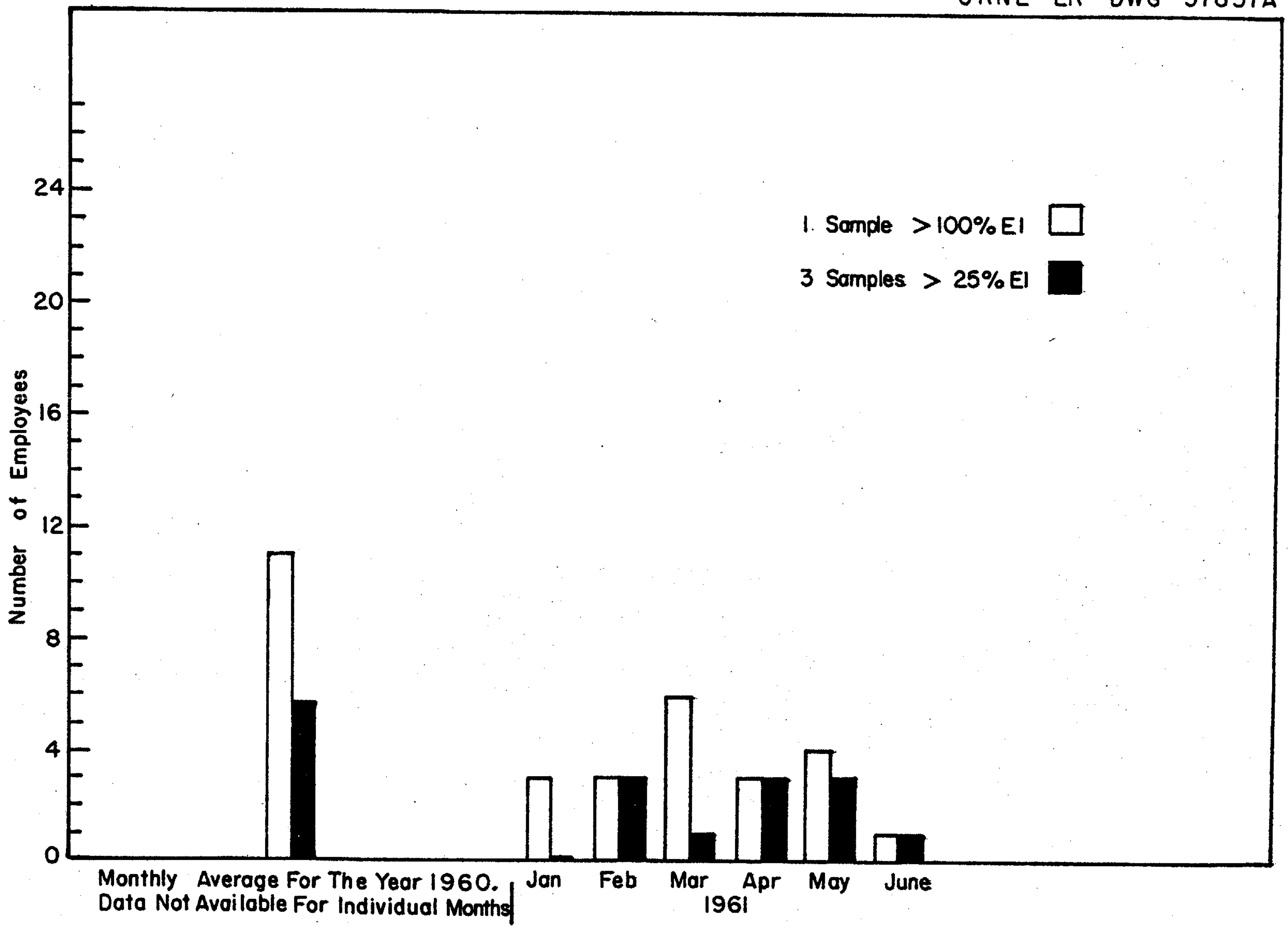

Fig.2 Number of Employees Who Submitted One Urine Specimen > 100% EI (Excretion Index) Or Three Consecutive Specimens > 25% EI

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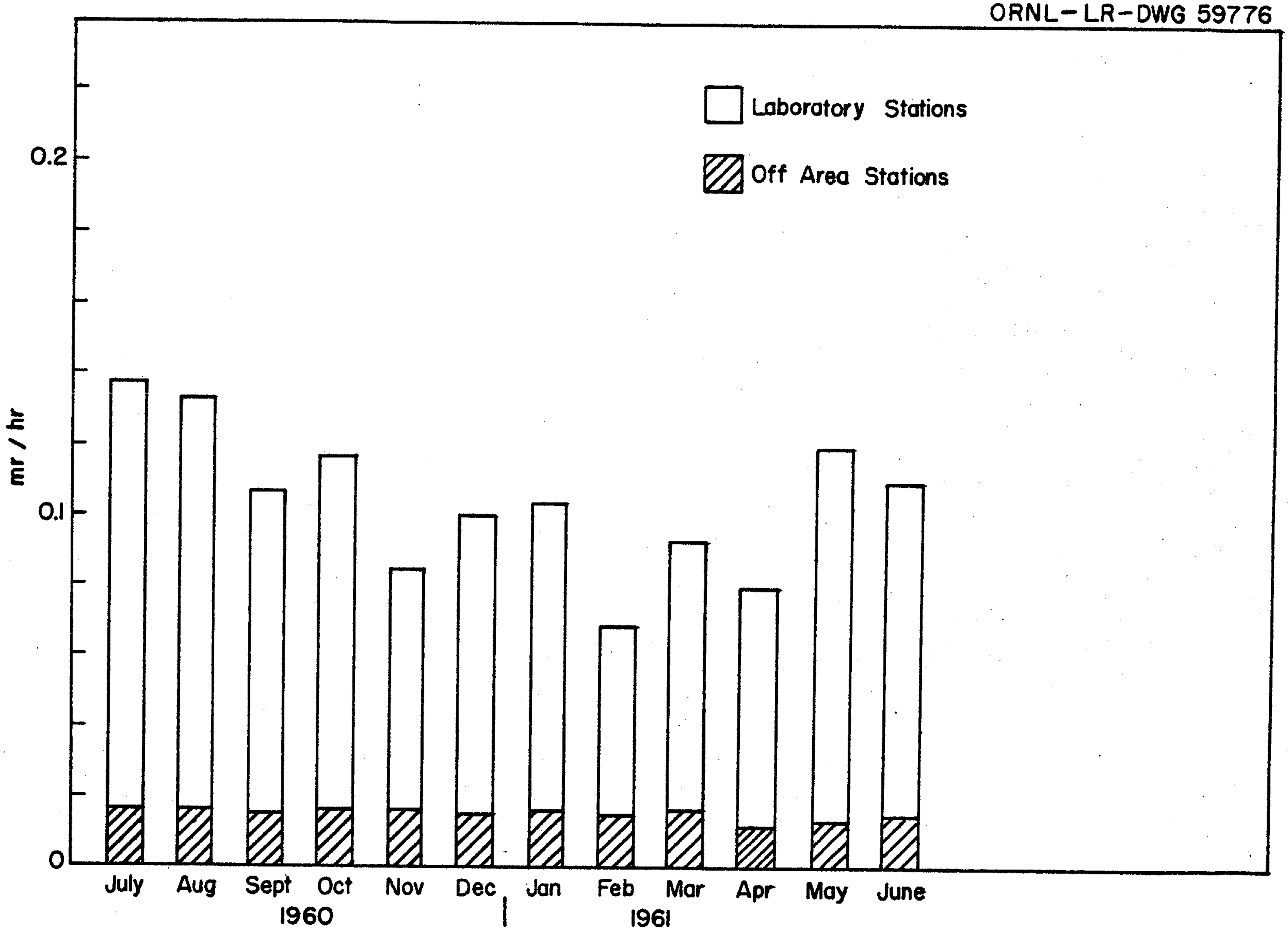

Fig.3A Average Radioactivity Background Reading

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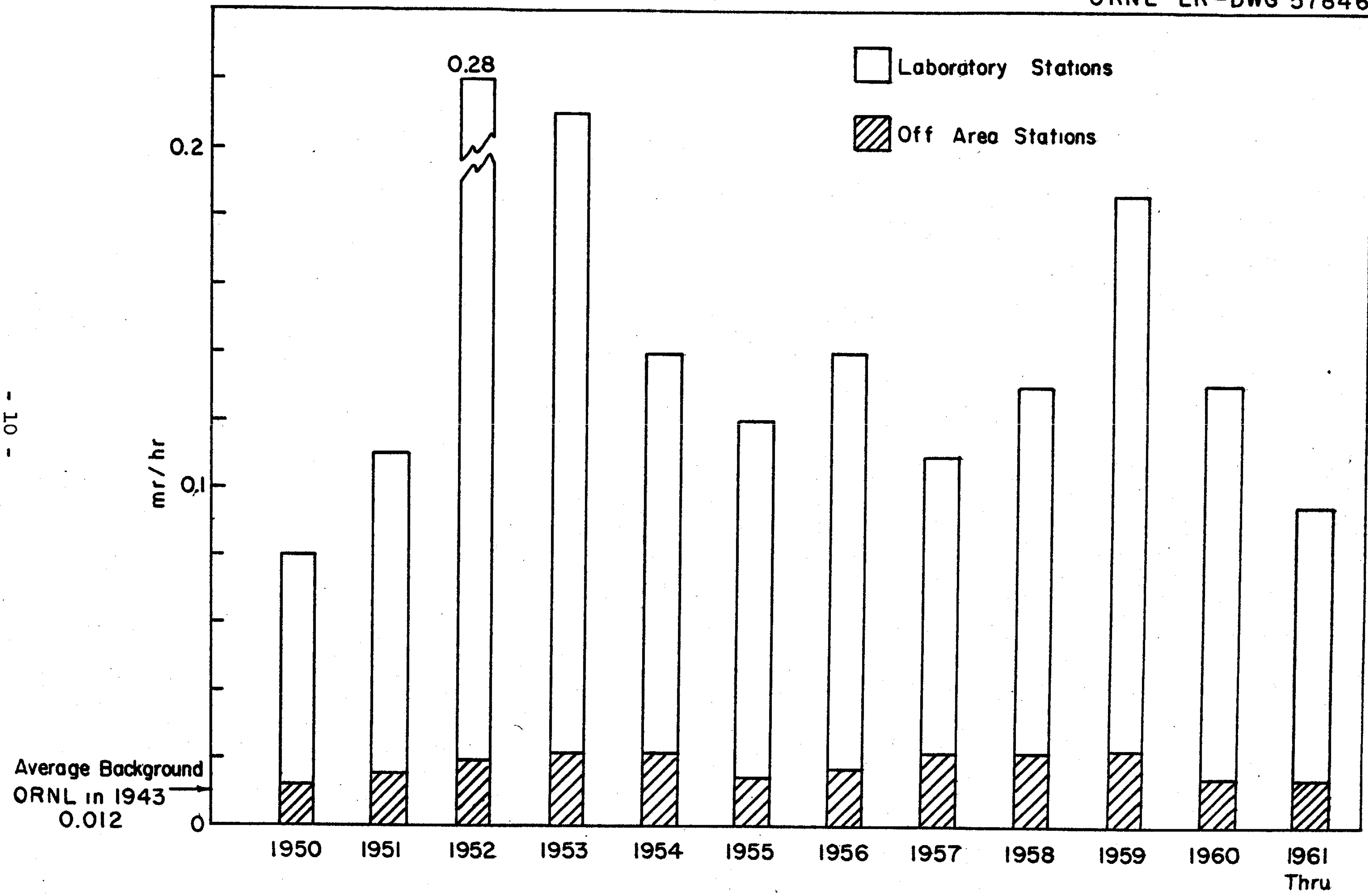

Fig. 3B Average Radioactivity Background Reading

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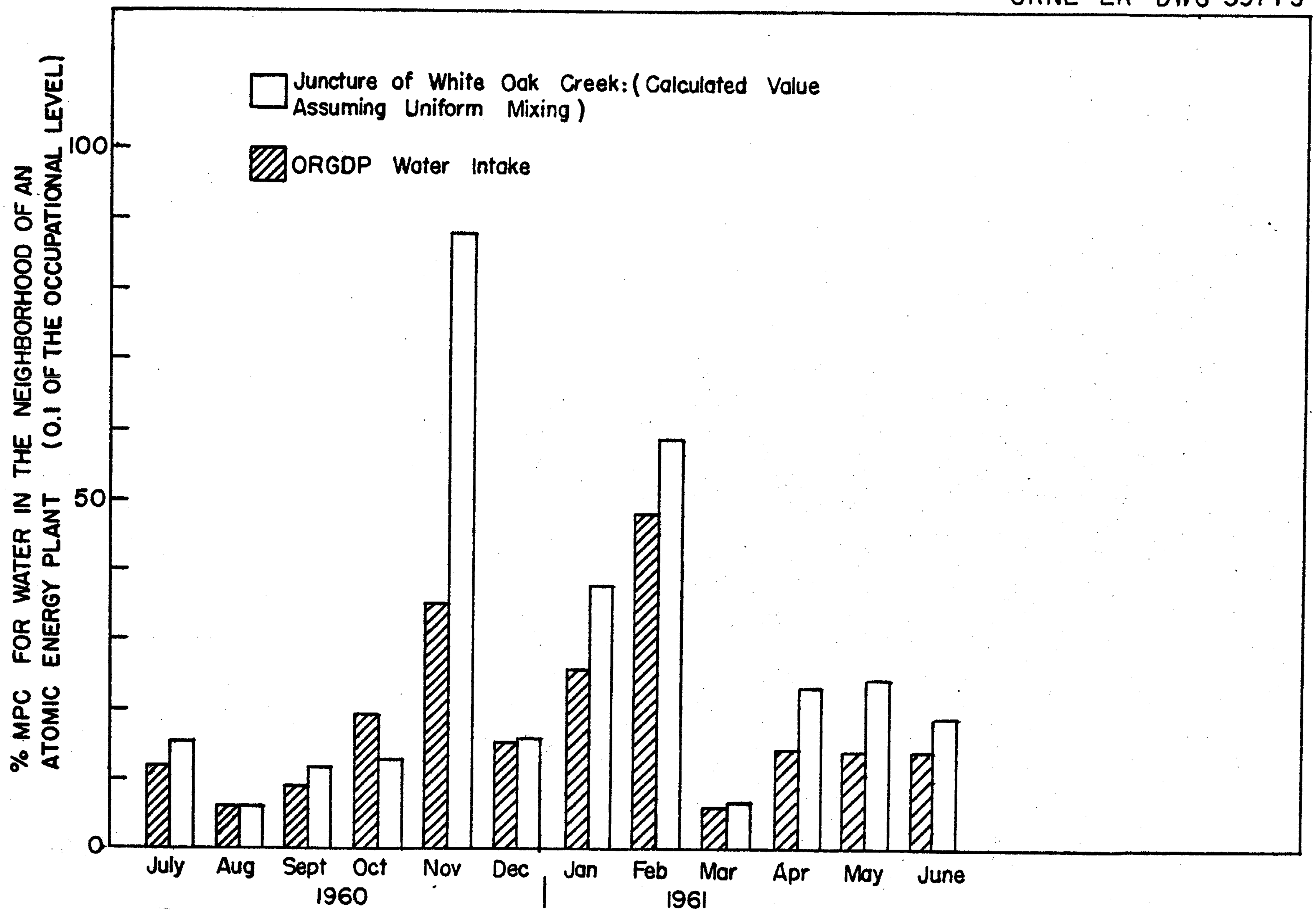

Fig. 4 A Radioactivity Measurements in the Clinch River

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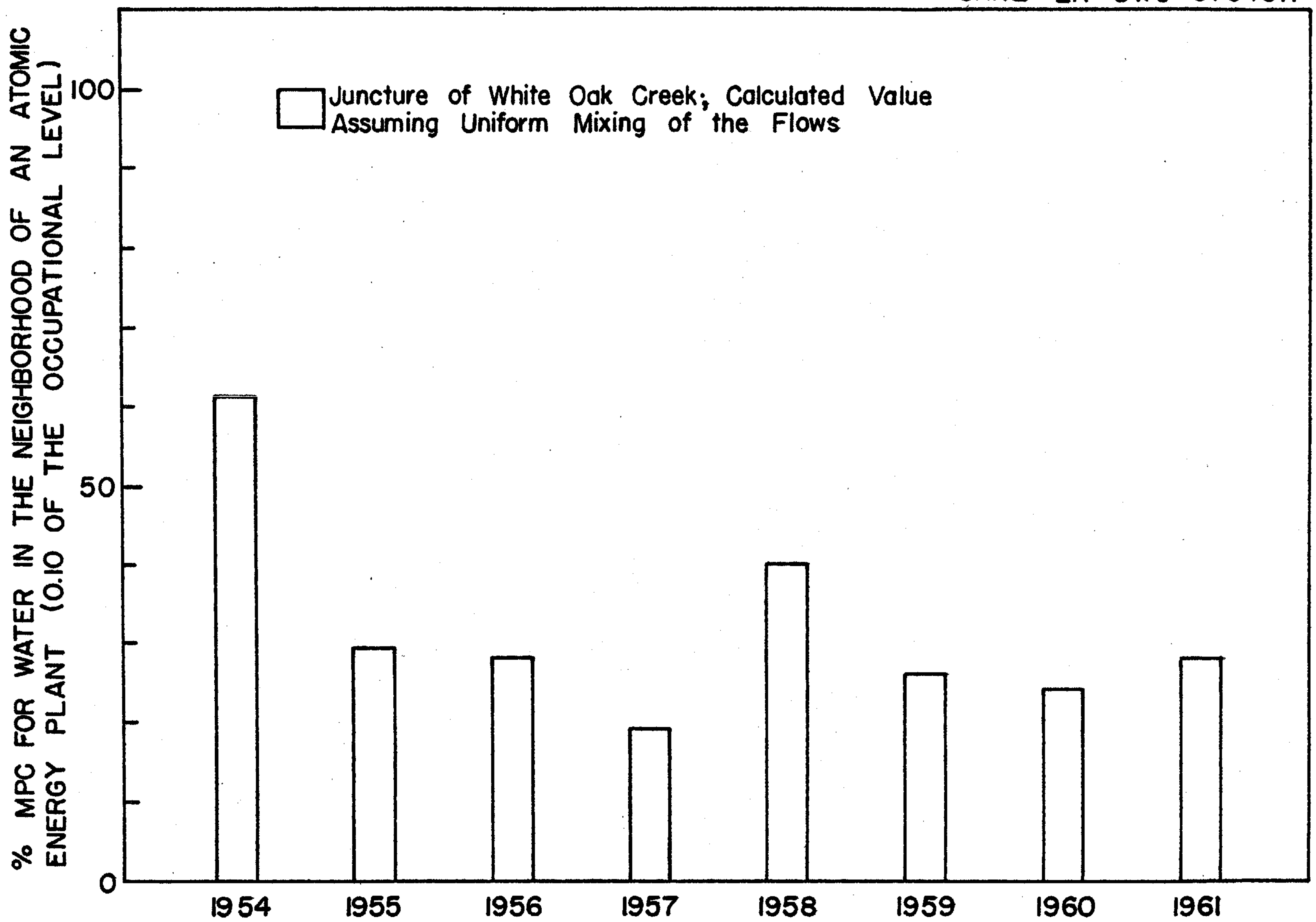

Fig. 4B Radioactivity Measurements in the Clinch River

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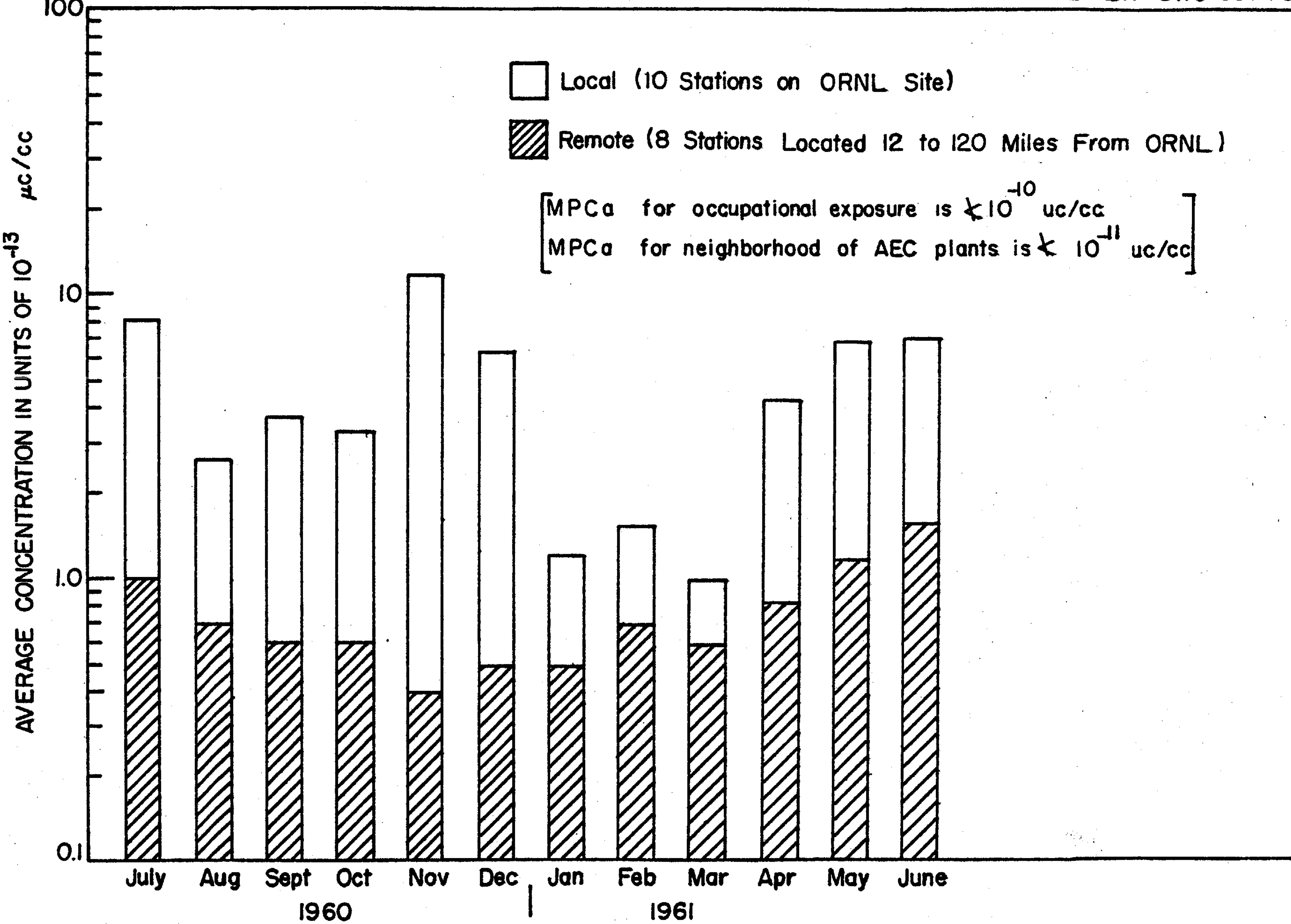

Fig.5A Airborne Radioactivity Measurements

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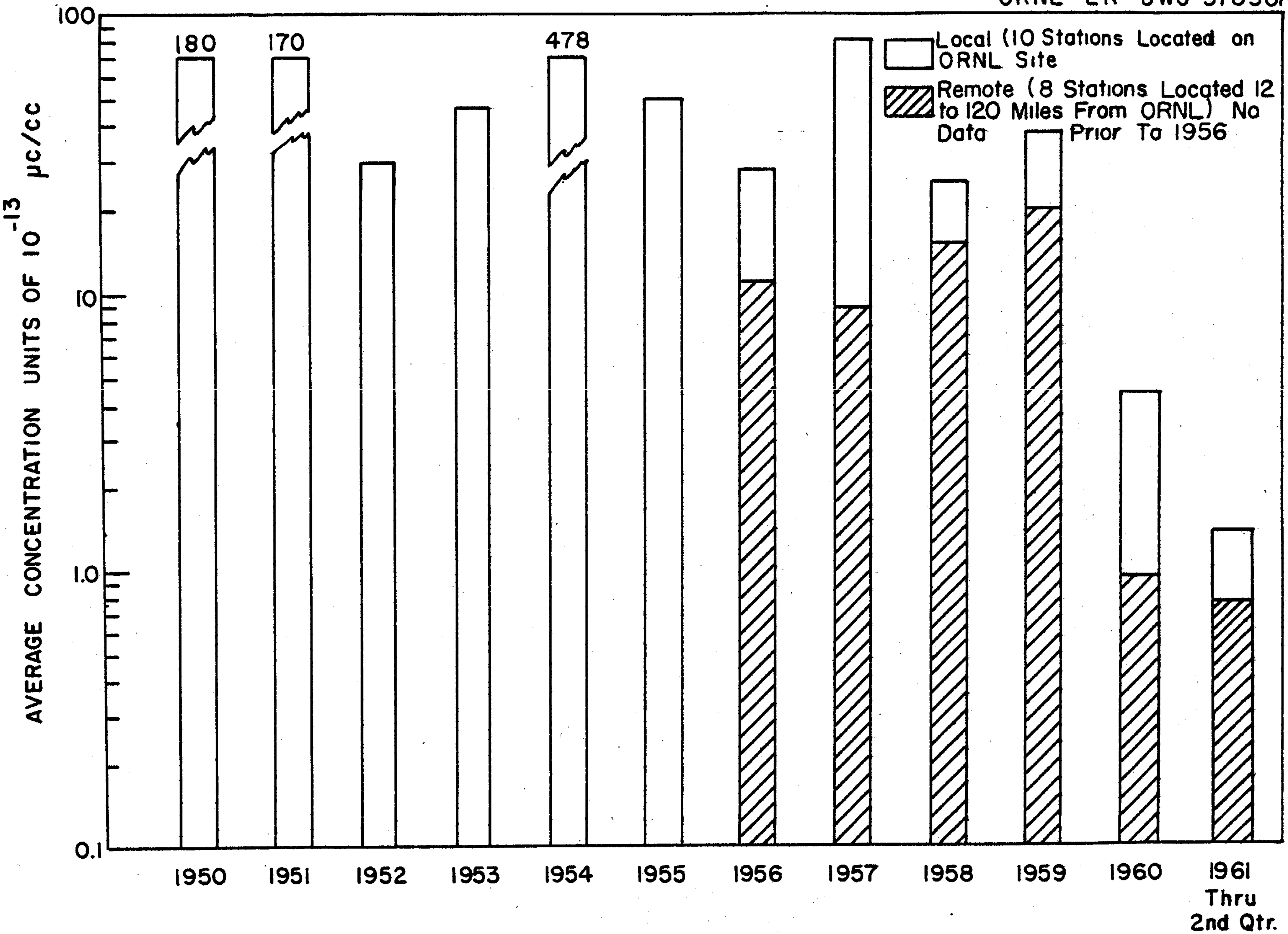

Fig. 5B Airborne Radioactivity Measurements

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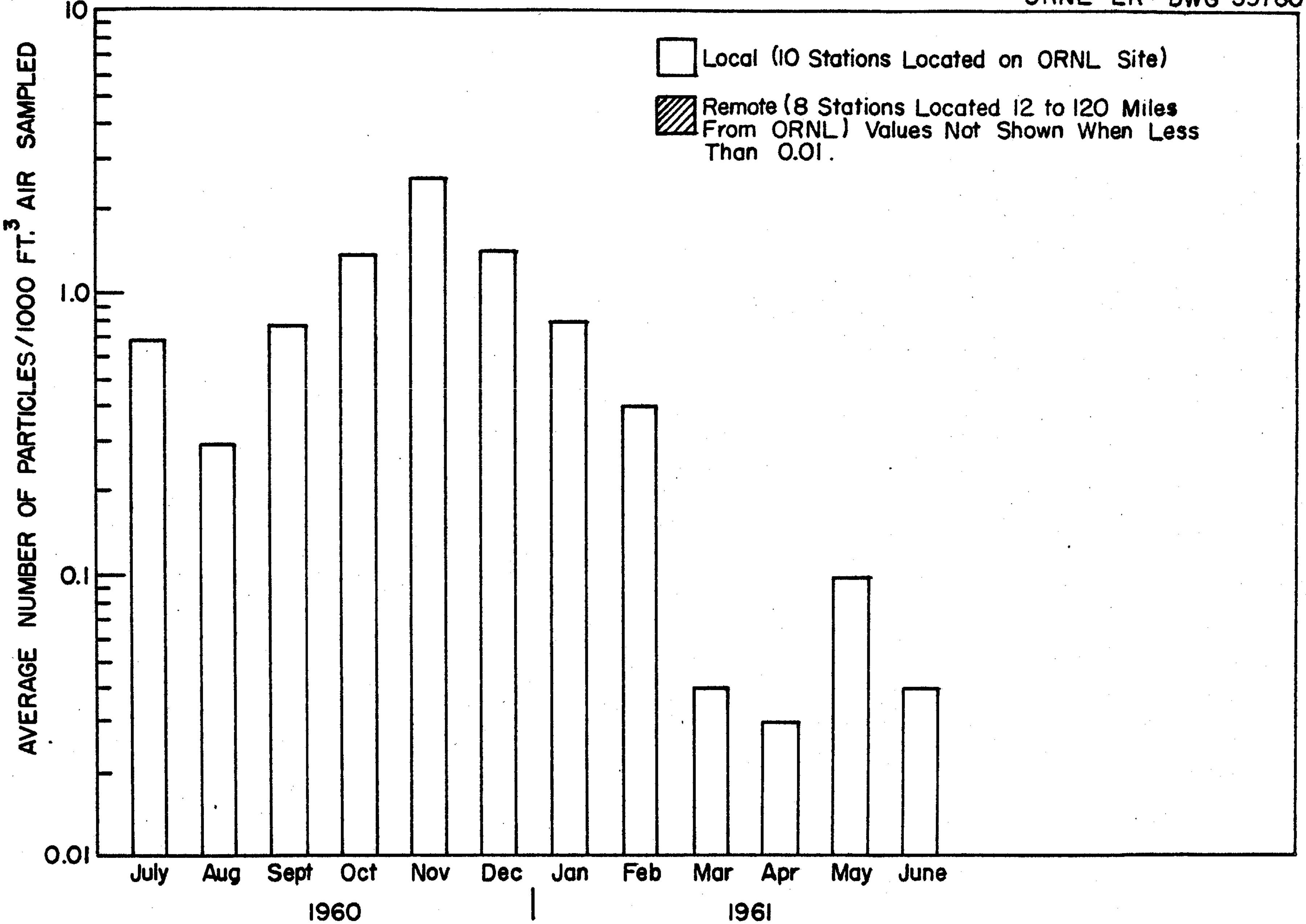

Fig.6A Airborne Radioactive Particles

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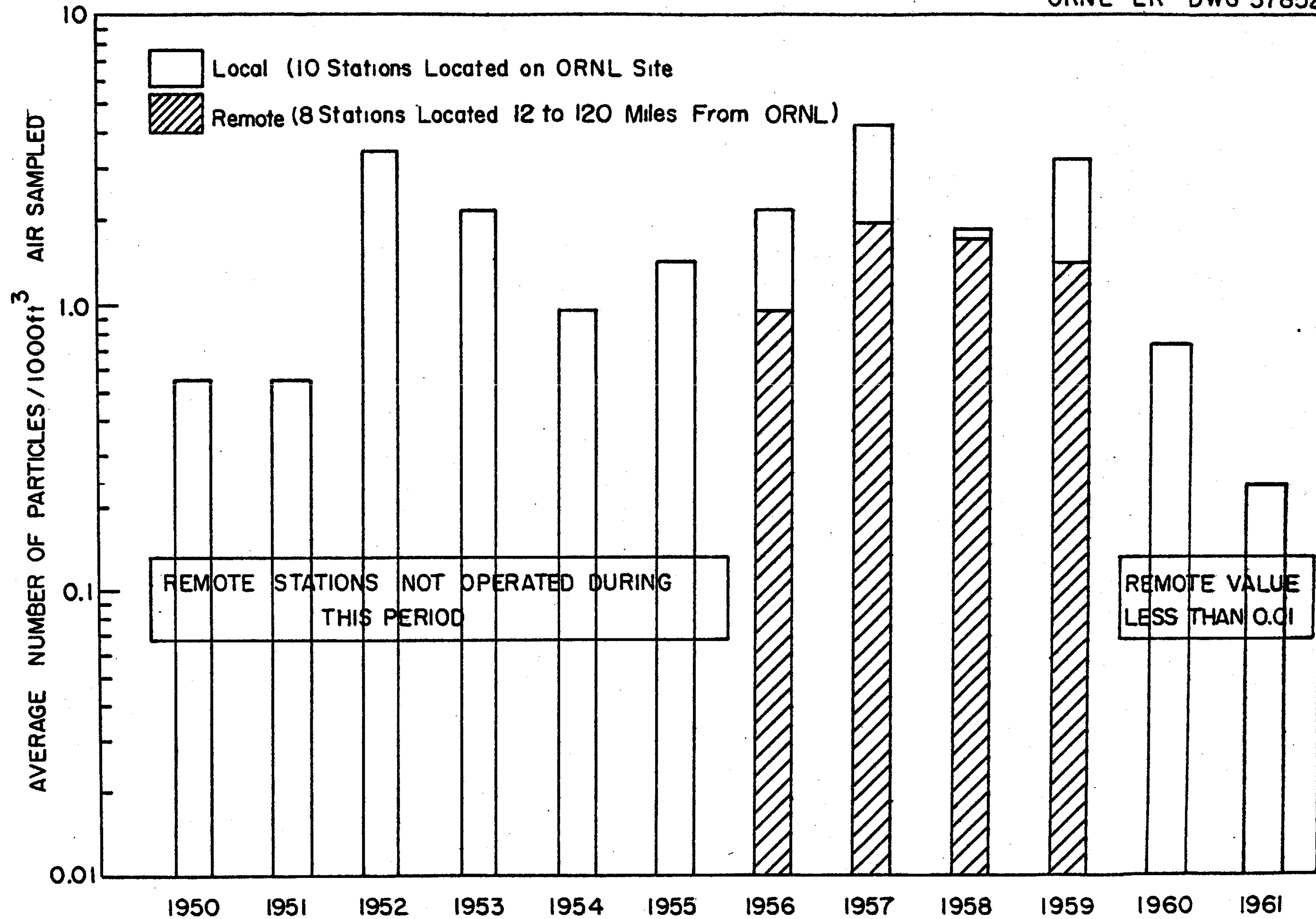

Fig.6B Airborne Radioactive Particles

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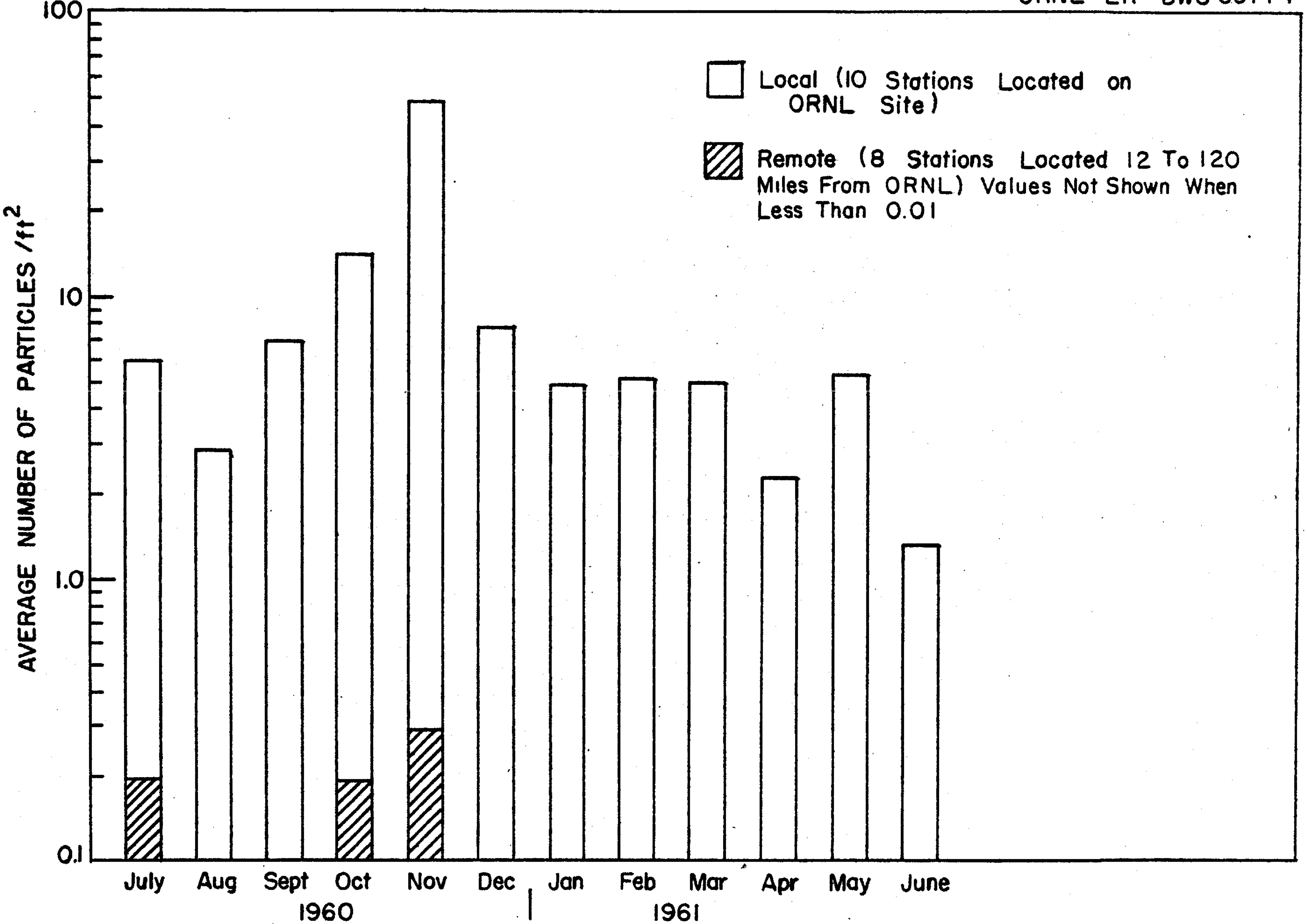

Fig. 7A Radioactive Particles Collected on Gummed Paper Trays

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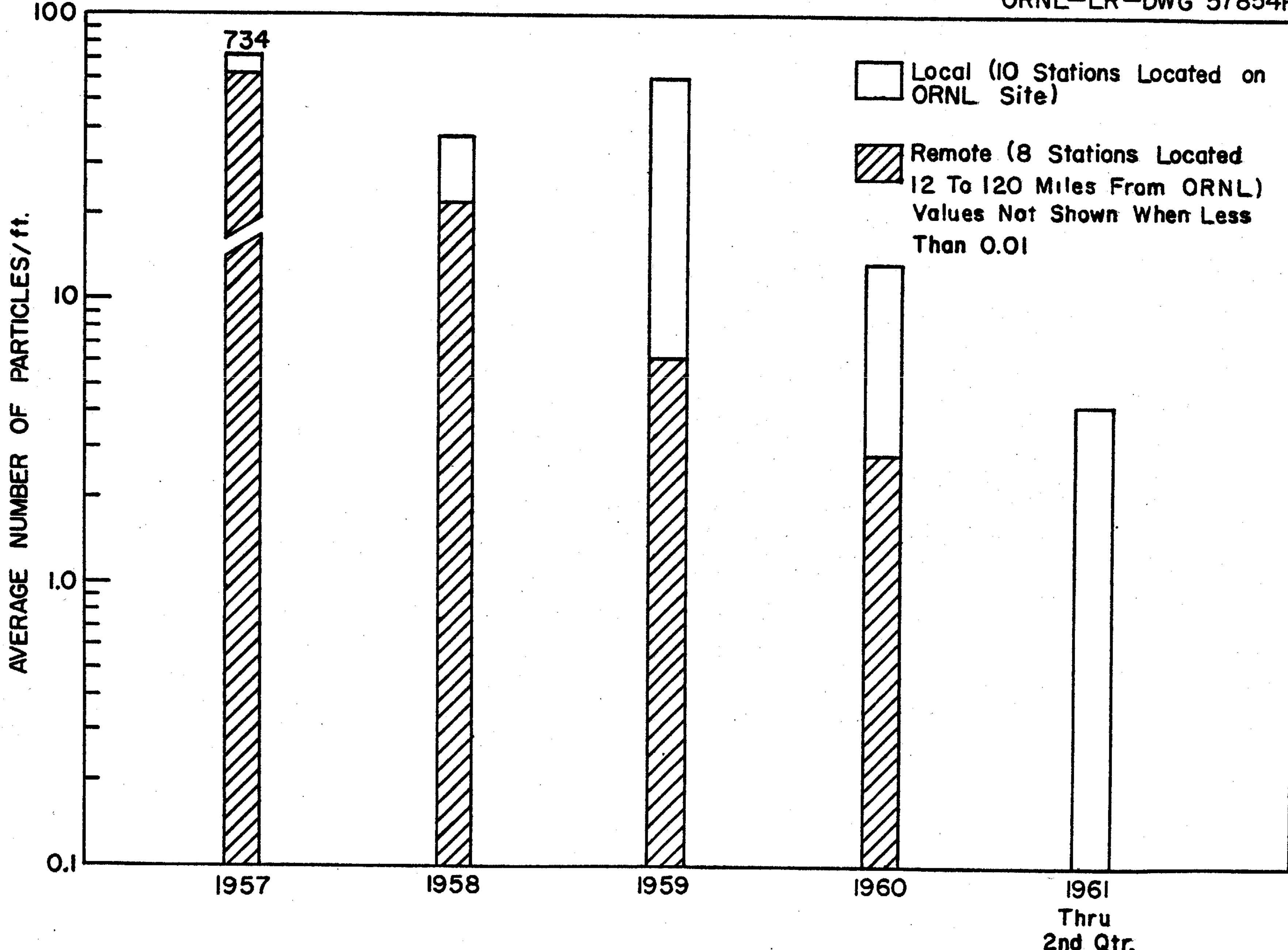

Fig.7B Radioactive Particles Collected on Gummed Paper Trays.

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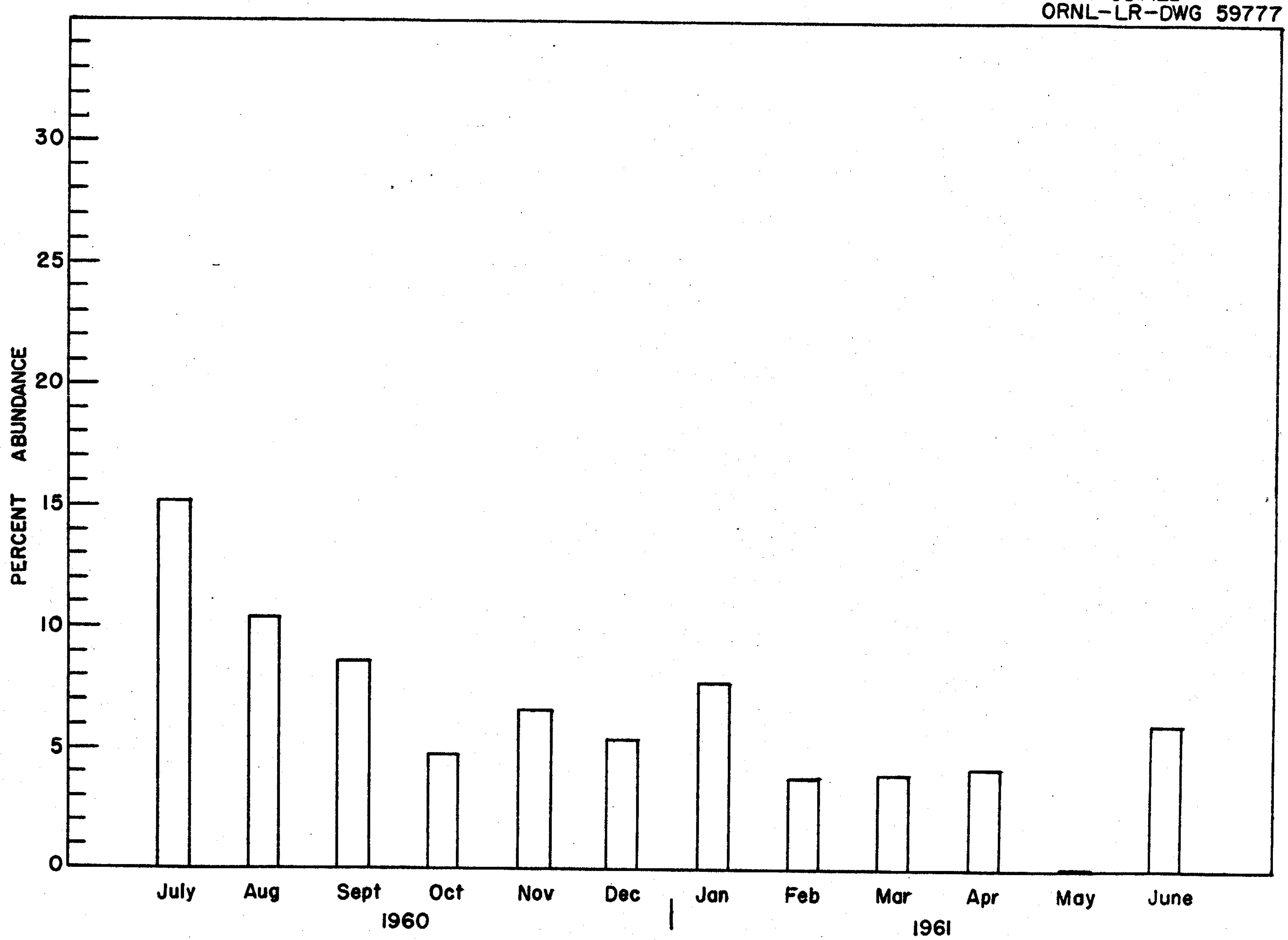

Fig. 8 Relative Abundance of Particles $> 10^5$ d/24 Hrs.

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77-82. Laboratory Records

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David R Hamrin 5/21/96
Technical Information Officer Date
ORNL Site

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HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - JULY THROUGH SEPTEMBER, 1961

J. C. Hart, Section Chief

DATA CONTRIBUTED BY:

H. H. Abee
T. J. Burnett
R. L. Clark
D. M. Davis
E. D. Gupton
L. C. Johnson
J. C. Ledbetter
O. D. Teague
A. D. Warden

Table of Contents

1.0 SUMMARY

There were no recorded radiation incidents[1] during the quarter. There were 24 unusual occurrences experienced which were categorized as minor events.[2] There were no exposures which exceeded the maximum permissible limits and no employee had a body burden which, for the previous 12-month period, exceeded the reportable level[1] of 50% of the maximum permissible when averaged over a period of one year. There were no major increases in radioactivity in the waste effluents; radiation background readings indicated only normal variations except for the effects of radioactive fall-out presumed to have originated from weapons tests performed by the U.S.S.R.

1.1 Unusual Occurrences

Twenty-four unusual occurrences (Table 1) were recorded during the third quarter. Twelve of these events involved principally the contamination of personnel, laboratory surface areas, or both. In addition, there were two fires, six wounds of varying severity potentially involving contamination, one release of contaminated water, and three events where air contamination was the primary source of concern. Only one of the air contamination events resulted in significant residual surface contamination.

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[1] Defined in Atomic Energy Commission Manual, Chapter OR-0623, "Radiation Exposure Reports".

[2] The method for classifying unusual occurrences is described in ORNL-3073, pp. 4-5.

In no case did an employee sustain a significant intake of radioactive materials.[3]

1.2 Personnel Monitoring Resume

The highest exposure sustained by an employee for the third quarter involved a skin dose of ~ 6.6 rem (Table 2) which is 66% of the maximum permissible quarterly dose (MPD_Q).[4] The second highest exposure sustained by an employee involved a whole body exposure of ~ 1.6 rem which represents 53% of the MPD_Q. The highest cumulative skin dose for the year through the third quarter was 18.8 rem or 63% of the maximum permissible annual dose (MPD_A). The highest cumulative whole body exposure for the same period was ~ 5.0 rem or 42% of the MPD_A. The individual who sustained the highest whole body dose for the quarter was the same employee who sustained the highest cumulative whole body dose for the year to date and as of September 25, 1961 this employee had accumulated ~ 41% of the maximum permissible dose permitted by the age proration formula 5(N-18).

The pocket meter data continue to correlate well with film badge dose data and are a valuable index of the external exposure status of employees who perform day-to-day routine operations involving radioactive materials.

---

3 Urine samples are requested as a standard precautionary measure from persons involved in unusual occurrences in those cases where an uncontrolled release of radioactive material occurs. Also, when appropriate, individuals may be requested to submit fecal samples and/or may be scheduled for checking in the whole body counter facility.

4 NCRP and FRC.

Figure 1 shows the number of persons per month whose pocket meter readings for that month averaged > 100 mrem per week.[5]

At the conclusion of the third quarter only two employees had accumulated a bone burden of Pu^{239} in excess of 30 per cent[6] of the maximum permissible as determined from urinalysis by currently established methods. Both employees have submitted urine samples routinely over the past several months and it appears likely that the deposition of Pu^{239} in bone will not exceed ~ 1/3 of the maximum permissible body burden.

1.3 Environmental Monitoring

An increase in radioparticulate fall-out,[7] presumably originating from the testing of nuclear weapons by the U.S.S.R., became evident during the month of September and radioparticulate fall-out affected background measurements in all phases of the air monitoring program.

---

5 These are persons who, for at least a month, have had a sustained exposure rate which is greater than 100 mrem per week. An exposure rate of 100 mrem per week is significant since, if continued, it produces the limiting accumulated dose to the whole body of 5(N-18) rem to age N years. The system further provides that cumulative pocket meter readings accrued during a quarter in excess of 1000 mrem and/or off-scale pocket meter readings (> 200 mrem/day) require the processing of the film badge meter. In all instances where film badge meters are processed for the above two reasons the results are supplied to the health physics area representative for evaluation and subsequent review by supervision.

6 The action point for curtailing an employee's exposure to internal emitters.

7 Gamma spectrometry indicated that the radioactive content of the fall-out material included Np^{239} and mixed fission products consisting primarily of Ba^{140} + La^{140}, Te^{132} + I^{132}, Mo^{99}, Zr^{95} + Nb^{95}, and I^{131}.

The average concentration of radioactive materials in air increased by approximately two orders of magnitude (Fig. 2) at both the LAM[8] and RAM[9] stations. The five off-area background stations showed a two-fold increase in the general background dose rate (Fig. 3) while the average background reading at the 50 stations located on or near the Laboratory site showed only slight increases over the average for the year to date. (The dose rate readings of the 50 on-site stations are normally 5 times, or more, the background dose rate reading at the off-area stations; therefore, the fall-out which began in September did not reflect a dramatic increase at the on-site stations.) During the month of September, the number of radioactive particles collected on filters at the LAM and RAM stations increased by at least three orders of magnitude (Fig. 4) over the number of particles collected during the month of August. Similarly, during the month of September, a marked increase was recorded in the number of radioactive particles collected on gummed paper fall-out collectors (Fig. 5) at the LAM and RAM stations. However, the ratio of the number of particles with a radioactive content of greater than 10^5 d/24 hrs to the total number of particles collected on gummed papers at the 10 LAM stations (Fig. 6) did not change significantly indicating that the specific activity of the particles is similar to that which had been observed earlier in the year.

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[8] LAM - Local Air Monitors consisting of 10 stations located at or near the X-10 site.

[9] RAM - Remote Air Monitors consisting of 8 stations located from 12 to 120 miles from ORNL.

Radioactive materials in the Clinch River in terms of the per cent of the maximum permissible concentration (MPC_w) decreased appreciably (Fig. 7) from the level recorded for the previous quarter. The decrease was due primarily to an increased flow of the river (greater dilution) and a reduction in the quantity of radioactive wastes discharged to the river during this period.

A survey of the ORNL roads and streets made on September 30 showed no significant contamination at any of the points surveyed. This is in sharp contrast with previous surveys where numerous contaminated spots resulting from accidental spills were recorded. The marked improvement observed in this recent survey is attributed largely to improved handling and transport methods used in the transfer of radioactive materials between facilities and in the transport of wastes to the Melton Valley area.

2.0 TABLES AND GRAPHS

Table 1. UNUSUAL OCCURRENCE REPORTS FOR THE THIRD QUARTER, 1961

JULY

1. Puncture Wound (Sr-90, Cs-137) Bldg. 3517 (F3P) - 7/8/61
2. Area Contamination from Ruptured Source (Cf-252) Lab. H-19, Bldg. 4500 - 7/8/61
3. Air Activity (FP gases) Bldg. 3005 (LITR) - 7/9/61
4. Personnel Contamination (Cs-137) South Cell, Bldg. 3031 - 7/18/61
5. Air Activity (FP gases) Cell B-2, Bldg. 3026-D - 7/25/61
6. Area Contamination from Dropped Source (Am-241) Bldg. 9201-2 - 7/24/61
7. Personnel and Area Contamination from Equipment Rupture (Th, U) Room BS74, Bldg. 4501 - 7/28/61

AUGUST

8. Area Contamination (U, Th) Room 11, Bldg. 2000 - 8/1/61
9. Contaminated Water Leak (Na-24, A-41) Bldg. 3042 (ORR) - 8/5/61
10. Area Contamination (Th) 100-A Loop Area, Bldg. 9204-1 - 8/6/61
11. Personnel and Area Contamination (I-131) East Cell, Bldg. 3028 - 8/7/61
12. Personnel Contamination (Pu-239, Am-241) Drain Line, Bldg. 3508 - 8/14/61
13. Personnel and Equipment Contamination (α, β, γ) Burial Ground # 5 - 8/17/61
14. Air and Surface Contamination (MFP) Crane Bay, Bldg. 7500 (HRT) - 8/17/61
15. Potential Wound Contamination (Pu-239) Cell 2, Bldg. 3019 (HPP) - 8/17/61
16. Radioactive Material Spill (U-depl.) Room 118, Bldg. 4501 - 8/22/61

SEPTEMBER

17. Personnel and Area Contamination (Pm-147, Am-241) E. Shed, Bldg. 3029 - 9/7/61
18. Potential Wound Contamination (Pu-239) Penthouse, Bldg. 3019 - 9/13/61
19. Contaminated Waste Can Fire (U) Room 42, Bldg. 2024 - 9/15/61
20. Personnel and Area Contamination (As-70,72,74) 86" Cyclotron, Bldg. 9201-3 - 9/15/61
21. NaK and Oil Fire (MFP) Cell A, Bldg. 3026-D - 9/20/61
22. Potential Wound Contamination (MFP) Burial Ground # 5 - 9/22/61
23. Severed Artery, Right Wrist (no contamination) Room A-23, Bldg. 3500 - 9/24/61
24. Hand Wound (no contamination) Burial Ground # 5 - 9/26/61

Table 2. PERSONNEL MONITORING EXPOSURE RESUME

Employee	Division	Third Quarter Dose (rem)			Cumulative Dose (rem) for 1st, 2nd and 3rd Qtrs 1961		
		D_s	D_c	% MPD_Q	D_s	D_c	% MPD_A
A	E and M	2.0	0.06	20 (D_s)	18.8	0.5	63 (D_s)
B	Isotopes	2.0	1.6	53 (D_c)	6.2	5.0	42 (D_c)
C	Isotopes	1.5	1.1	37 (D_c)	6.2	4.9	41 (D_c)
D	Isotopes	6.6	.6	66 (D_s)	11.4	2.7	38 (D_s)
E	Isotopes	2.0	1.4	47 (D_c)	6.0	4.3	36 (D_c)
F	Isotopes	1.8	1.1	33 (D_c)	5.3	3.5	29 (D_c)
G	Isotopes	1.3	0.9	30 (D_c)	4.6	3.4	28 (D_c)
H	Health Physics	2.4	1.5	50 (D_c)	4.3	2.8	23 (D_c)
I	Isotopes	1.4	1.1	37 (D_c)	4.7	2.6	22 (D_c)
J	Isotopes	3.4	1.0	34 (D_s)	3.9	2.2	18 (D_c)
K	Isotopes	1.6	1.4	47 (D_c)	2.0	1.8	15 (D_c)

Note: Table 2 includes (1) all employees whose quarterly dose exceeded 5.0 rem for the skin (D_s) of the whole body or 1.0 rem for the total body (D_c), and (2) all employees whose dose for the year to date exceeds a D_s of 15.0 rem or a D_c of 3.0 rem. The MPD_Q is the maximum permissible dose allowed in a calendar quarter (13 weeks); the MPD_A is the maximum permissible dose allowed in a year.

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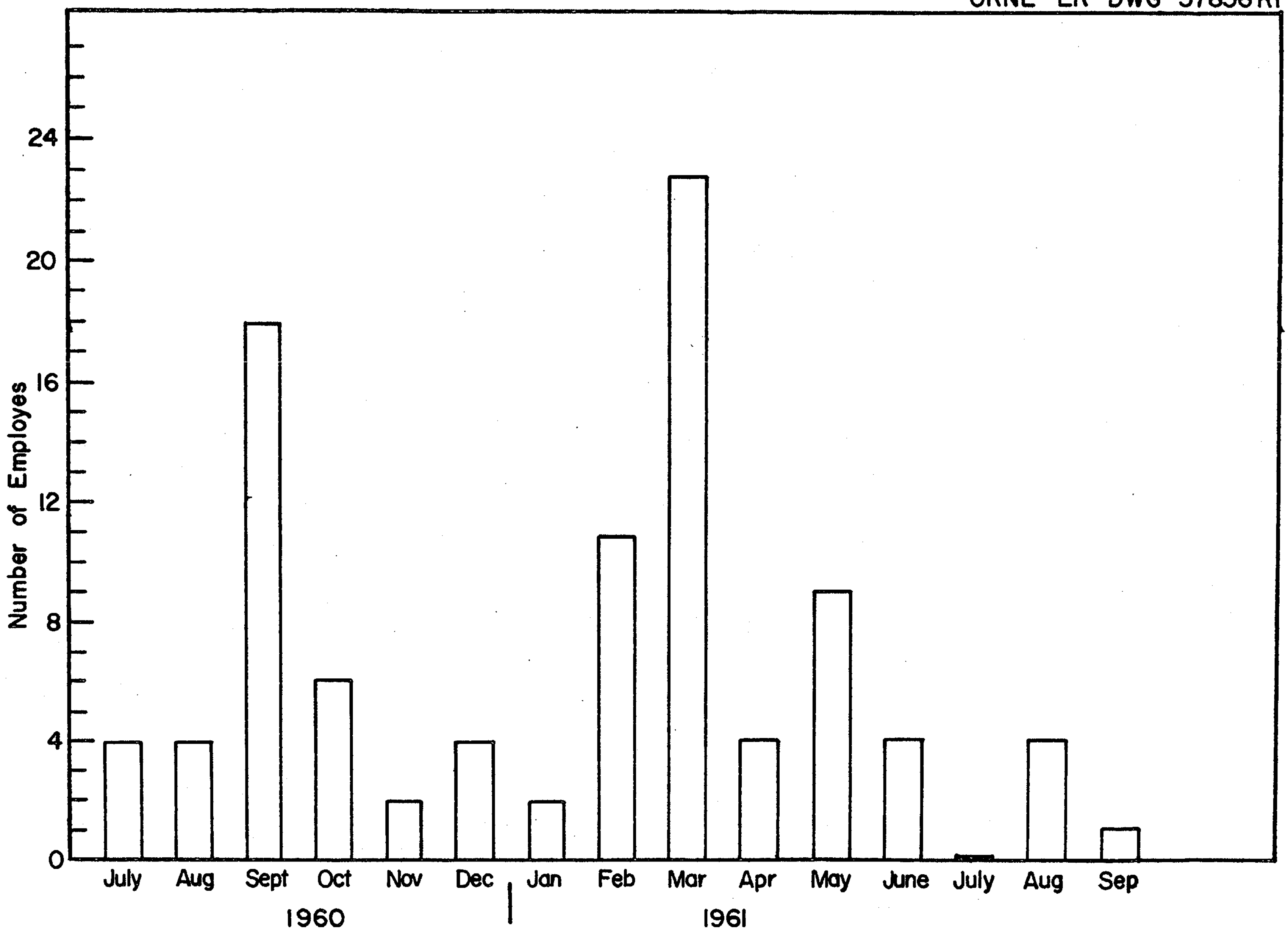

Fig 1 Number of Persons Whose Pocket Meter Readings Exceeded an Average of 100 mrem/WK

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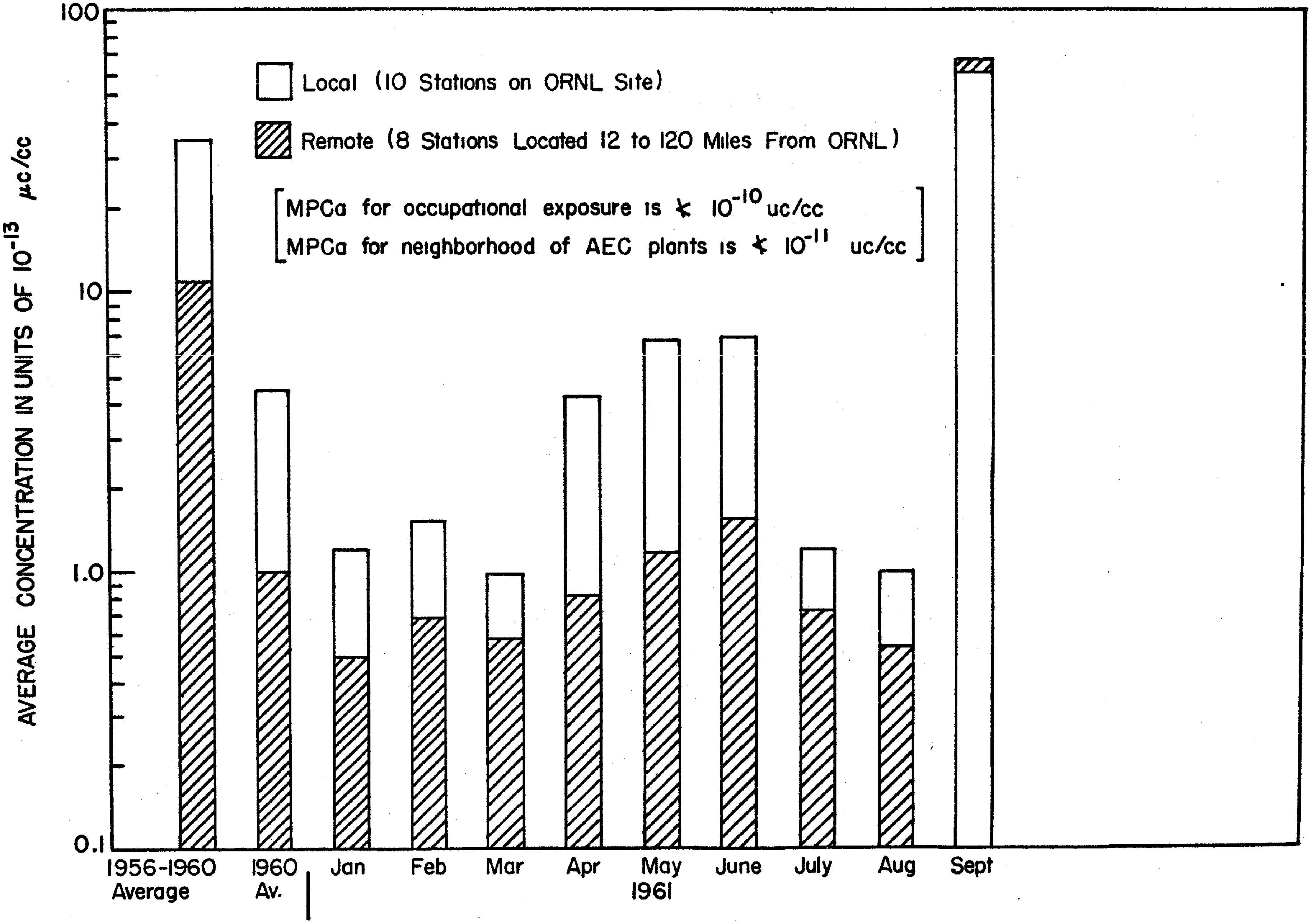

Fig. 2 Airborne Radioactivity Measurements (Filter Paper Data)

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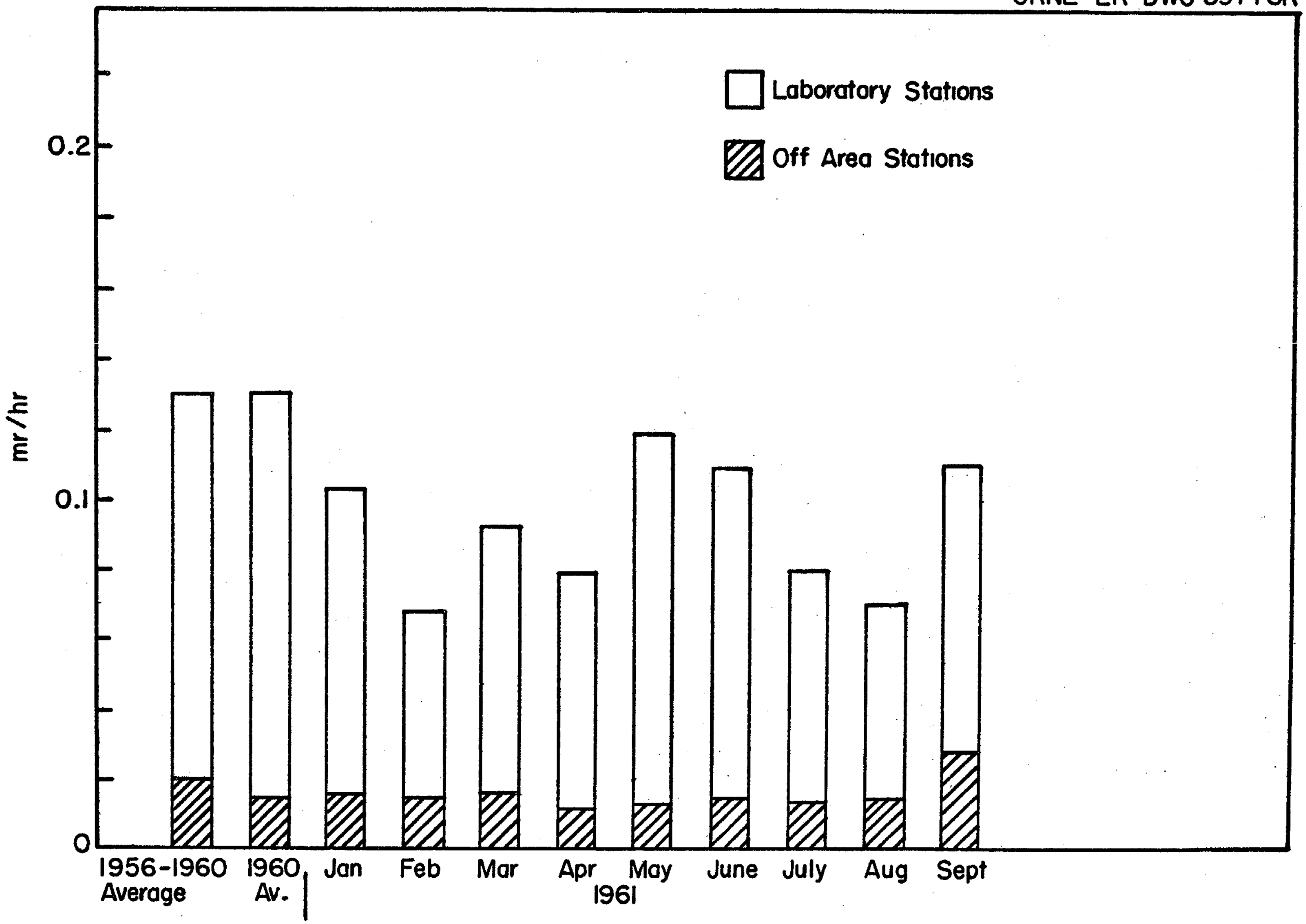

Fig. 3 Average Radioactivity Background Reading.

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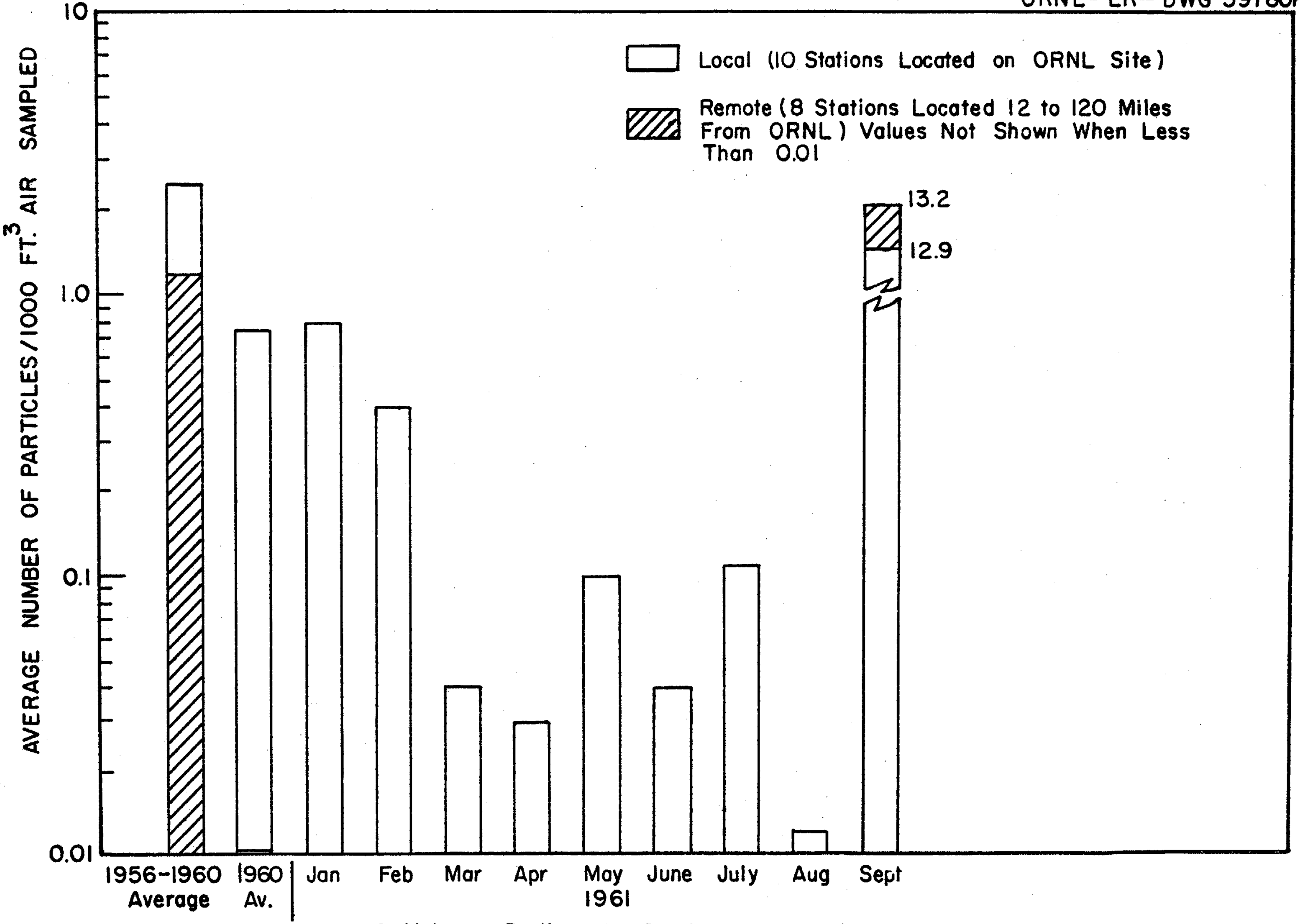

Fig. 4 Airborne Radioactive Particles Collected On Filters (Measured by Autoradiographic Techniques)

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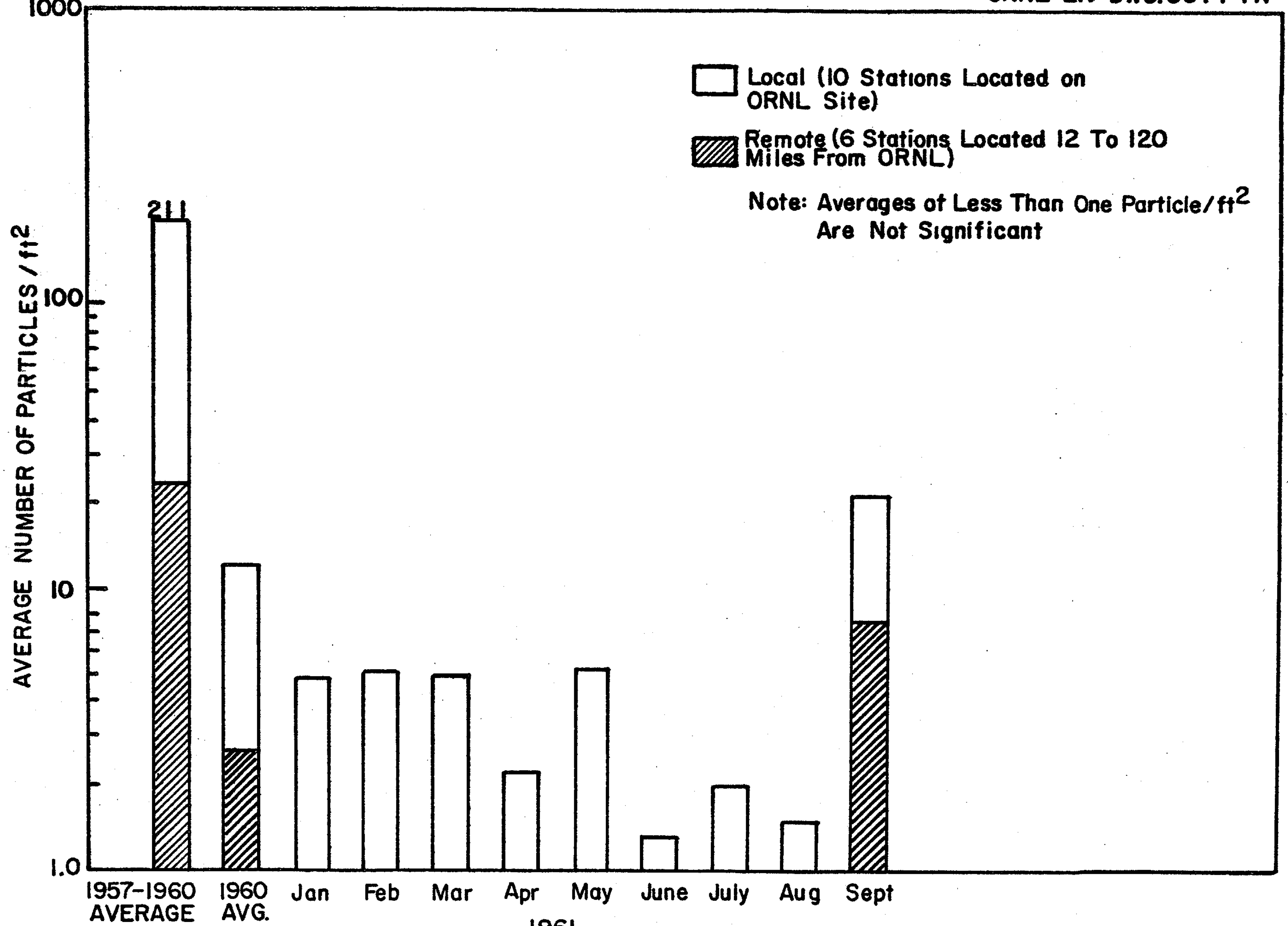

Fig. 5 Radioactive Particles Collected on Gummed Paper Trays (Measured by Autoradiographic Techniques)

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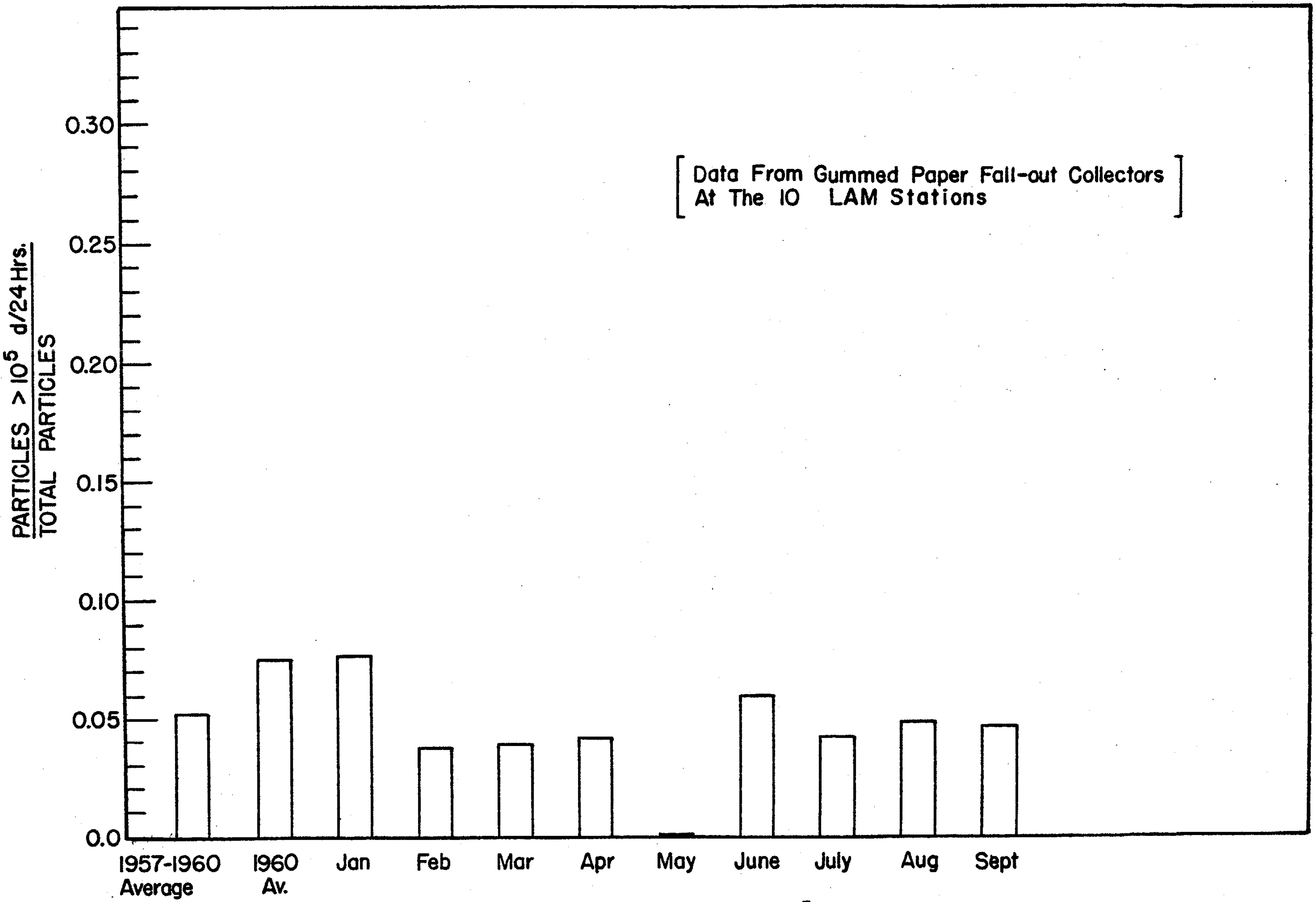

Fig. 6 The Ratio of Particles With Activity Greater Than 10^5 d/24 hrs. To The Total Number of Particles Collected.

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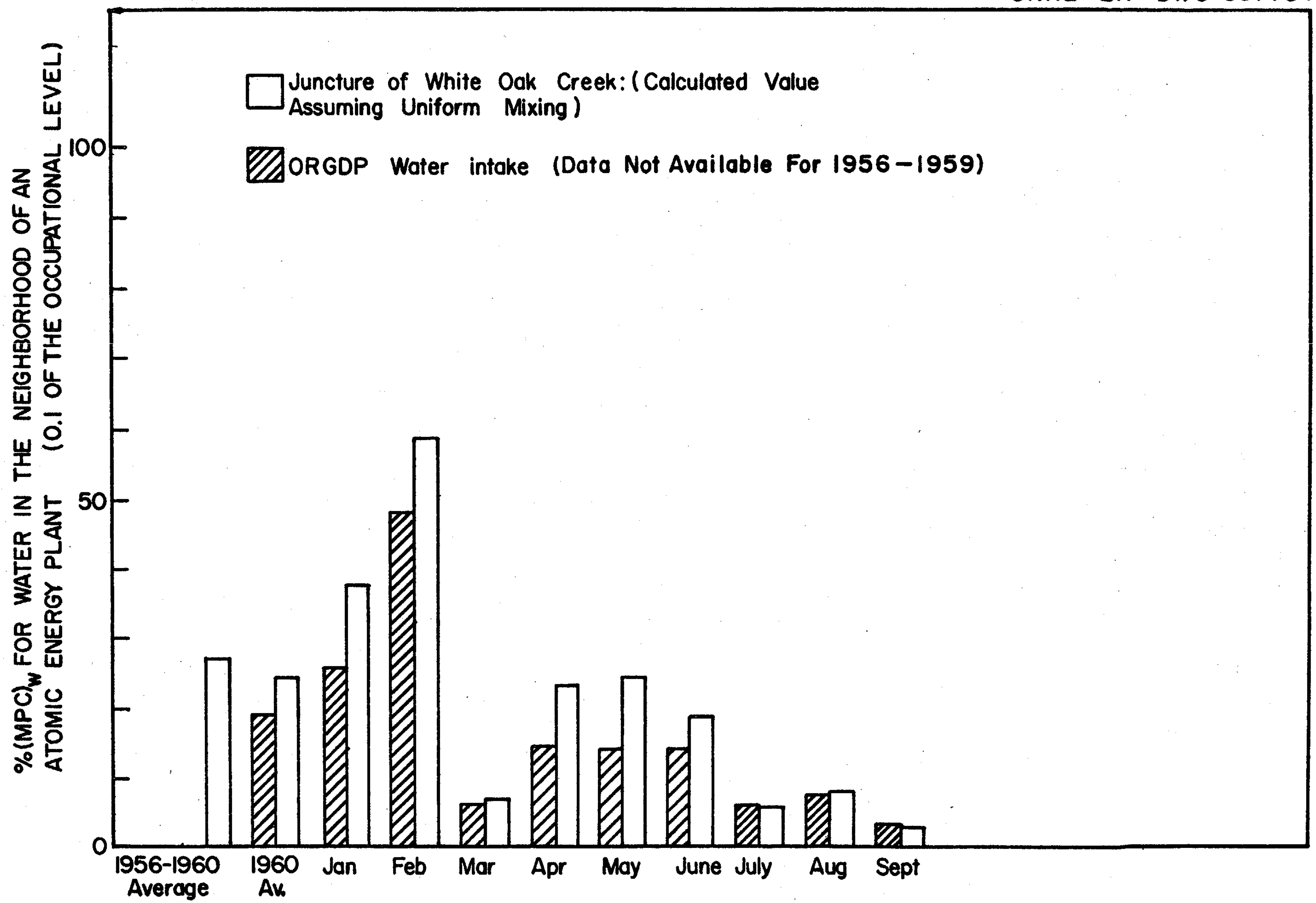

Fig. 7 Radioactivity Measurements in the Clinch River

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HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - OCTOBER THROUGH DECEMBER, 1961

J. C. Hart, Section Chief

Data Contributed By:

H. H. Abee	E. D. Gupton
T. J. Burnett	L. C. Johnson
R. L. Clark	J. C. Ledbetter
D. M. Davis	O. D. Teague

A. D. Warden

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1.0 SUMMARY

During the quarter 22 unusual occurrences were recorded, one of which was classified as a major event[1] and became reportable[2] to the AEC as a radiation incident. The reportable incident involved beta burns on the hands of an employee and represented the only personnel exposure sustained during the quarter in excess of permissible levels. Discharges of radioactive wastes to the environment were within permissible levels and there were no major increases in radioactivity in gaseous waste effluents. However, the radioactivity discharged to the Clinch River through White Oak Dam increased by a factor of two over the third quarter. Radiation background readings were normal except for the continuing influence of radioactive fall-out presumably originating from weapons testing.

2.0 UNUSUAL OCCURRENCES

Twenty-two unusual occurrences were recorded during the fourth quarter. One of these events was classified as a major event by Laboratory standards and was evaluated by an investigation committee consisting of ORNL and AEC-ORO representatives. The 21 minor events were classified as follows: Twelve events involved principally the contamination of personnel, equipment, laboratory surface areas or combinations of the three; three minor wounds involving potential contamination were treated at the dispensary; three events involved only air activity; a criticality excursion presented a temporary contamination problem and a rise in radiation background requiring special controls for a short period

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[1] The method for classifying unusual occurrences is described in ORNL-3073, pp. 4-5.

[2] Defined in Atomic Energy Commission Manual, Chapter OR-0623, "Radiation Exposure Reports".

of time; one fire occurred involving radioactive materials; and a damaged shipping waste container was found leaking at a Knoxville express terminal.

1. A RbCl target ruptured at the 86" cyclotron after approximately fifteen minutes of bombardment releasing the radioactive contents of the target material into the machine and cooling water. This resulted in gross contamination of the pit area.

Two employees contaminated their work clothing and sustained minor contamination of the hands. Pocket meters were worn by both employees and the highest reading was 45 mr. Analysis of urine specimens indicated no significant internal exposure.

2. Approximately 25 grams of uranium powder ignited and burned on top of a work bench in one of the metallurgical facilities. The fire resulted following the transfer of the powder from a glass container to a polyethylene bottle. Only minor contamination resulted and it was confined to a small area at the work bench. Urinalysis performed for the one employee involved indicated no significant internal exposure.

3. A routine survey of sample material brought to a counting room in Bldg. 3001 led to the discovery of alpha contamination on a desk located in the room. Surveys of work benches, desk tops, and floor areas indicated U^{234} contamination spread generally over the room.

Air samples taken in the room indicated no significant air-borne contamination. Employees, known to have been in the room, were found free of contamination at the time and urine sample results indicated no significant internal exposures.

Decontamination procedures required about three man days of effort. The circumstances which led to the contamination of the area were not determined;

however, it was recommended that the work area be placed on a routine survey schedule and good housekeeping techniques be reviewed.

4. A coolant water line at the 86" cyclotron ruptured filling the tank to about 75% of its capacity. It was recommended that some mechanical means be devised to dry out the machine and that personnel should not enter the tank. However, on a later shift, two employees entered the tank and contamination was spread outside the controlled area. Pocket meters worn by the two employees read 145 and 95 mr respectively. Urine and fecal samples indicated that no significant internal exposure was incurred.

5. While performing operations on two irradiated fused salt specimens located in the defilming section of a corrosion examination facility cell, an employee received beta burns to the tips of the thumb, index, third and fourth fingers of the left hand; the tip of the thumb, side of index finger, and side and tip of the third fingers of the right hand were involved but to a lesser degree.

The employee first reported to the dispensary on November 1 with a complaint of "numbness" at the tip of the index finger of the left hand. Although there was no evidence of radiation injury at this time, the employee alluded to the possibility of his having received an exposure and was asked by the physician to report daily for further observation. On November 6 it became evident to the physician that a radiation burn was very probable and a committee was appointed to investigate the circumstances of the case.

The exposure is believed to have been sustained on two separate occasions as follows: On October 21 the employee made the decision to perform manually a chipping operation on the fuel specimen holding the specimen in a pair of forceps with the left hand while chipping the surface of the specimen with an X-acto knife held in the right hand. Then, two days later on October 23, the employee attempted to flex a specimen from a silicone rubber mold with his left hand and actually removed the specimen from the mold with his left index finger and thumb. He had previously measured the source strength as 10 rad/hr at 3 feet, but grossly misjudged the dose rate at distances of very close approach. Measurements were made on representative samples of the irradiated material and the actual dose rate of the specimen attenuated by the thickness of a rubber glove was estimated to be approximately 125 rad/sec. A mockup of the cell was constructed and attempts were made to duplicate the operations performed by the employee using non-radioactive replicas. Using elapsed time and distance studies derived from motion pictures made of the above proceedings, the dose was estimated to have been at least 1200 rem.

The accident points up the necessity for familiarizing all personnel with the hazard associated with the direct handling of radioactive materials. Further, supervisors must keep under close surveillance potentially hazardous operations to ensure that employees use safe procedures at all times.

6. An employee received a head laceration when he walked under a manipulator arm in the cell access area at Bldg. 3025. Although a survey of the manipulator arm showed contamination of approximately 2000 d/m β,γ activity, no contamination was detected at the site of the wound.

To prevent a recurrence of this nature, the placing of padding on manipulator arms, where feasible, was recommended.

7. Air activity occurred in the ORR when flange blanks on the B-9 air sweep line were removed to install a repaired section of line that had been taken out previously. The air monitors operating in the building showed a rise in background to approximately 50% of the masking level. The two employees who had been repairing the air sweep line were contaminated slightly and had dosimeter readings of about 20 mr each.

All personnel that had an opportunity to be in the building during the event were checked for contamination. Although no contamination was found on clothing, nasal smears indicated the presence of air-borne contamination.

A thorough probe and smear survey of the building indicated that most of the contamination on the floors was the result of tracking. Horizontal and vertical surfaces above floor level were free of contamination.

Urinalysis data indicated no significant exposures. However, whole body counter techniques indicated the presence of less than 3% of the maximum permissible level of Co^{58}, Co^{60}, and Cr^{57} for the two employees engaged in the repair operation.

8. The dismantling of an experiment resulted in the spread of contamination in the south hot cell facility at the ORR. The material causing the contamination was approximately 200 grams of tantalum which had been utilized as a thermal shield for the experiment. During the period of irradiation considerable Ta^{182} was formed from the oxidizing tantalum shield. When an attempt was made to flush the oxidized tantalum down the cell hot drain, backup action occurred in other hot drain lines in the building and radiation readings were detected as high as 10 r/hr on certain unshielded portions of the drain line. There was no evidence of air activity.

The backup was due to the fact that the drainage system did not have sufficient capacity to handle flushing operations. Steps have since been taken to correct this problem by adding additional drain lines.

9. The dismantling and inspection of a Giannini pressure transmitter that had been removed from the HN-1 facility in the ORR resulted in personnel and area contamination. The transmitter was dismantled in the instrument shop and later inspected in Bldg. 3005 (LITR). Work benches and floors in both areas

were contaminated to readings of 35 mr/hr; however, the contamination was confined to rather small areas and cleanup proceedings were started immediately alleviating much of the problem.

Two employees performing the dismantling and inspection work were contaminated, requiring the removal and disposal of work garments and hand decontamination. Analysis indicated the principal materials involved to be Ce^{144}, Cs^{137}, and Co^{60}. Urine specimens submitted for analysis, as well as whole body counting results, indicated no significant internal exposures to personnel. It was recommended that supervision require that a radiation-contamination survey be made prior to removal of equipment from the ORR experimental facilities.

10. A product cylinder containing approximately 90% enriched uranium in a compound of UF_6 was placed in a plastic bag, removed from Cell 2 in Bldg. 3019, and transported to Room 100 for weighing. As the plastic bag was being opened, the employee detected fumes escaping. He immediately resealed the plastic bag and notified his supervisor.

A radiation survey of the employee indicated no personal contamination although the scales were contaminated to a slight degree. Urinalysis later indicated that no significant internal exposure occurred. A recommendation was made to (a) place the weighing station in a more isolated location and (b) require the use of respiratory protection during the weighing operation.

11. A criticality excursion occurred in the east test cell of Bldg. 9213. Ventilation fans were turned off, the cell doors taped, and the resulting contamination confined mainly to the cell area. The highest instrument reading obtained through the control room door approximately five minutes after the excursion indicated a 10 rad/hr field. Three hours later an instrument reading at the same location indicated a radiation field of less than .01 rad/hr. Most of the radioactivity inside the test cell was short lived and decayed rapidly.

Film badge data indicated no significant external exposures. The analysis of urine and fecal samples indicated that no significant internal exposures resulted.

12. An employee received a finger wound while dismantling thermocouple assemblies in the cell access at Bldg. 3025. A screw driver slipped as pressure was being applied, pierced a glove worn by the employee, and punctured the middle finger of the left hand. Subsequent checks revealed no significant contamination in the wound. A smear check of the screw driver indicated approximately 1.4×10^3 d/m β,γ activity and no significant α activity.

Urinalysis and a whole body counter check indicated no significant internal exposure as the result of this occurrence.

Internal contamination through puncture wounds continues to present an internal exposure potential where direct maintenance is performed on contaminated equipment with contaminated tools. At best, gloves provide only partial protection and the potential for accidents of this type decreases in direct proportion to the amount of skill and care that will be exercised.

13. An ampule containing one curie of Xe^{133} ruptured in Bldg. 3028E setting off alarms connected to the building air monitors and monitrons. The ampule had been placed on the floor while other manipulations were being made preparatory to placing the ampule in a shipping container. It is believed that the rupture occurred as the result of an excessive buildup of pressure within the ampule following a heat sealing operation. The highest instrument reading obtained in the area shortly after the rupture indicated approximately 100 mrad/hr.

Pocket meters worn by employees in the building at the time of the occurrence indicated that the maximum dose received by an employee was about 25 mr.

Improvement in the design of the Xe^{133} operation was started on the day following this occurrence which should aid in the prevention of similar occurrences.

14. A bottle containing 5 liters of uranium nitrate solution (400 grams/ liter of U^{235}) dislodged and spilled in Room 201, Bldg. 9213. The liquid seeped through the floor and metal grating to a lower level contaminating some of the equipment located there. Clothing and hand contamination problems were handled without difficulty.

All personnel involved in cleanup operations were requested to submit urine samples for analysis. Positive evidence of trace quantities of internal contamination was indicated in the case of two employees who were involved. The exposure was not considered to be significant.

15. Three employees were contaminated while installing a water jet line from the uranium storage area to a floor drain in the west end of the pipe tunnel, Bldg. 3019. The storage area had been used for storing U^{233}, and the line was being installed in preparation for decontamination operations prior to equipment removal. Although all recommended equipment for personnel protection was worn during this work, failure to tape the face hoods to the coveralls resulted in contamination of the neck and throat area of the three employees. In addition, one employee contaminated his hands during the removal of his contaminated garments. However, analysis of urine specimens indicated no significant internal exposure.

In order to prevent a recurrence of this nature, personnel will be required during future operations of this type to wear plastic suits with a positive air supply. Also the suits will be washed down and carefully monitored prior to removal.

16. A noticeable increase in the counting rate of a hand and foot counter located in Bldg. 4507 led to an investigation which revealed contaminated UHF lines leading from Cell 4 into the operating area. Radioactive materials had

flowed into the lines during a non-routine checking operation involving the salt transfer lines. Instrument readings indicated that some lines were contaminated as high as 2 rad/hr with a moisture trap reading 8 rad/hr. It became necessary to remove the contaminated trap and hot lines and the operation was completed without incident.

Film badges worn by personnel working in the operating area were processed and all exposures were well below maximum permissible levels. Urinalysis indicated no significant internal exposures.

17. A cardboard package containing radioactive wastes being shipped to ORNL from the Texas Instruments Company, Dallas, Texas, was discovered by warehouse personnel at the Roadway Express Terminal, Knoxville, Tennessee, to have been damaged in transit. A survey made at the terminal by Health Physics personnel indicated a small area of low level contamination on the floor of the trailer that had brought the container to Knoxville. A survey of a second trailer involved in transporting the package to ORNL was checked and one spot of contamination was found on the floor of the trailer. The radioactive waste in the damaged container was identified as Co^{57}, Fe^{59}, P^{32}, Au^{198}, and Sb^{121}.

Both trailers involved were decontaminated at ORNL before release.

18. An employee received a slight puncture wound, through rubber gloves, on the ball of his left thumb while placing new filters into a metal frame in Cell 16, Bldg. 3517. The metal frame was surveyed and Cs^{137} was determined to be the principal contaminant counting in places as high as 3×10^3 d/m β,γ.

When the wound was surveyed at the dispensary, traces of contamination were found and reduced to background by a soap and water rinse.

Urinalysis indicated no significant internal exposure.

19. A 15-minute disruption of the exhaust system serving the Analytical Chemistry labs and cells in Bldg. 3019 led to a routine probe and smear survey

to determine if there had been any leaks from hoods as the result of the exhaust system failure. The survey indicated general contamination on the floor of the operating areas east of HRLAF cells with the highest level of contamination (probe reading of 4×10^5 d/m α) found located around a hood near the center of the east wall of the operating area. The shoes of a number of employees were found to be contaminated probing as high as 10^4 d/m α. The hallways and most of the HRLAF operating area were cleaned to permissible levels before the end of the work day. The tile floor in front of the hood where the spill occurred had to be replaced.

It was determined that the contamination was not the result of the exhaust system failure but had occurred prior to that time. Investigation of stains on the hood ledge indicated that the contamination resulted from the spillage of a liquid source. Pulse height analysis indicated the material to be Am^{241}. No Sr was detected.

Urinalysis indicated no significant internal exposure.

Due to the fact that the spill was not reported at the time it happened to area supervision or Health Physics, the recommendation was made that all employees be informed of the necessity of reporting radioactive spills immediately. Had such immediate action been taken in this case, the contamination could have been isolated, confined to a smaller area, and resulted in much less cleanup effort.

20. As the demineralizer system was being readied for service, prior to starting up the LITR, a hose connecting the pumps to a resin column became disconnected. This allowed the reactor water from the reservoir to be released through the pump and resin columns. An estimated 1000 gallons of water and 3-5 gallons of resin were released. The water escaped under the north door of the building and flowed down the street eastward to the intersection of a roadway

near Bldg. 3010. At this point the stream turned and flowed northward approximately 50 feet. The street was contaminated up to 2 mr/hr requiring decontamination and re-surfacing in places. Radiation readings as high as 1.5 r/hr were associated with the spilled resin.

No personnel were in the immediate area at the time of the release and no exposures resulted from this occurrence.

The recommendation was made that permanent piping and valving replace the present use of rubber hoses in that part of the system.

21. The contamination of a section of a paved street resulted when a yellow "hot" can was removed from its regular storage place and located adjacent to a freshly painted area in the middle of the street for the purpose of preventing vehicles from passing over the wet paint. When it was observed by supervision that a "hot" can had been used for the above purpose, a radiation survey was effected. The pavement was found to be contaminated up to 1 r/hr and paper towel smears taken on the street were contaminated up to 0.1 r/hr. A survey of the "hot" can and its contents gave radiation readings as high as 6 r/hr.

All personnel and vehicles known to have had access to the area were checked and found to be free of contamination. The "hot" can contained Cs^{137} contaminants.

The above occurrence points up the necessity of making certain that all Laboratory personnel understand zoning procedures and other Laboratory regulations governing the care, use, and transfer of radioactive waste disposal containers.

22. Extensive contamination of the floor and adjacent areas of a high level analytical facility resulted when an access drawer in a shielded cell was opened to permit the addition of acid to a beaker which had been used to evaporate an irradiated fuel sample. A technician was removing the beaker and its contents

from the access drawer when a monitron located nearby alarmed. Upon hearing the alarm, the technician returned the beaker hastily to the drawer and in performing this operation some of the contents splashed over the cell face, floor, and parts of the technician's clothing.

Disregarding the suggestion of a fellow employee to remove his clothing, the technician departed for a change room in another area leaving a trail of radioactivity along his route out of the building, down a side street, and into the change house. After removing his clothing, the coveralls were placed in a laundry bag containing other soiled clothing and when recovered were found to read 10 r/hr at a distance of three inches from a survey meter probe.

A check of the employee's midsection, where most of the material had splashed on his coveralls, indicated some residual skin contamination which was removed easily following scrubbings with soap and water. The film badge meters (worn during the fourth quarter through December 18) indicated whole body exposures of little significance. No significant internal dose was indicated from this occurrence as determined by body fluids analysis and whole body counter techniques.

An investigation of the circumstances surrounding the occurrence indicated that the employee violated operating procedures by not monitoring the transfer drawer as it was opened. His failure to remove his contaminated clothing in the controlled area and to effect decontamination procedures there indicated that more emphasis needs to be placed upon fundamentals in the handling of radioactivity.

3.0 PERSONNEL MONITORING

An employee sustained beta radiation burns on his hands during the quarter while performing operations in a hot cell operated by one of the research divisions. The point of maximum exposure, as determined by experimental methods, was at least

1200 rem and the tissue which received the maximum dose was centered around the tips of the thumb and index finger of the left hand. The dose to parts of the body other than the hands was negligible. A summary of conditions which led to the exposure is given in Section 2.0, Part 5, of this report.

The highest whole body exposure recorded during the quarter was 1.7 rem (see Table 5.1) which is 57% of the maximum permissible quarterly dose (MPD_Q). The second highest exposure sustained by an employee in this category was 1.6 rem which represents 53% of the MPD_Q. The highest whole body skin dose recorded during the quarter was 2.4 rem which is less than 25% of the MPD_Q for this type of exposure.

The highest whole body cumulative dose for the year through the fourth quarter was a skin dose of 18.8 rem which is 63% of the maximum permissible annual dose (MPD_A) for the skin of the whole body. The second highest cumulative whole body exposure for the same period was a critical organ dose of 6.3 rem which represents 53% of the MPD_A for this type of exposure.

At the conclusion of the fourth quarter three employees had accumulated a bone burden of Pu^{239} in excess of 30 per cent[3] of the maximum permissible level as determined from urinalysis by currently established methods. These employees have submitted urine samples routinely over the past several months and it appears likely that the deposition of Pu^{239} in bone will not exceed approximately 1/3 of the maximum permissible body burden.

During the quarter 74 individual examinations were performed by whole body counter techniques. A discussion concerning the present whole body counter program is presented in the appendix of this report by members of the Health Physics Technology Section.

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[3] The action point for curtailing an employee's exposure to internal emitters.

4.0 ENVIRONMENTAL MONITORING

Atmospheric contamination continued to be one or two orders of magnitude greater than before the arrival of weapons fall-out in this area during the latter part of September. However, the average concentration of radioactive materials in air for the fourth quarter was less (Fig. 5.2) by approximately 35% than the peak value shown during the month of September. The number of radioactive particles collected on air monitoring filters and detected by autoradiographic techniques (Fig. 5.3) showed an even greater decrease of approximately 65%. Unlike the filter paper data which peaked during the month of September, the gummed paper-autoradiographic data did not peak until November (Fig. 5.4) with a reduction occurring in December of about 1/2 of the November peak value. The ratio of the number of particles with a radioactive content greater than 10^5 dis/24 hrs to the total number of particles collected at the 10 LAM[4] stations decreased during the quarter (Fig. 5.5). The 50 area background stations located on the Laboratory area show the Laboratory background to be essentially the same as before the fall-out picture changed in September (Fig. 5.6) while the five off-site stations indicate that background just off the Laboratory site remains at approximately 30% above the general norm observed just prior to September. It may be concluded from an examination of the data presented above that the increased radiation background levels observed as the result of fall-out was largely due to weapons testing and not directly attributable to local operations. This interpretation is further supported by data accrued by the Health Physics Technology Section regarding levels of radioactive materials found in foods and by measurement of I^{131} uptake in thyroids of cattle and humans. (See Appendix 6.1)

The per cent of maximum permissible concentration (MPC_w) of radioactive materials in the Clinch River began to rise (Fig. 5.7) in November and reached ap-

[4] LAM's - Local Air Monitors consisting of 10 stations located at or near the X-10 site.

proximately 20% of the MPC_w during December. The increase was due primarily to decreased flow in the river and to a twofold increase in the amount of radioactivity discharged to the river.

5.0 TABLES AND GRAPHS

Table 5.1 PERSONNEL MONITORING EXPOSURE RESUME

Employee	Division	Fourth Quarter Dose (rem)			Cumulative Dose for 1961 (rem)		
		D_s	D_c	% MPD_Q	D_s	D_c	% MPD_A
A	Isotopes	1.4	1.0	33 (D_c)	5.1	3.7	31 (D_c)
B	Isotopes	1.6	1.4	47 (D_c)	6.8	6.3	53 (D_c)
C	Isotopes	1.6	1.3	43 (D_c)	7.8	6.2	52 (D_c)
D	Isotopes	1.2	1.2	40 (D_c)	1.4	1.2	10 (D_c)
E	Isotopes	2.4	1.7	57 (D_c)	7.1	4.2	35 (D_c)
F	Isotopes	1.5	1.3	43 (D_c)	7.7	6.3	53 (D_c)
G	Isotopes	2.0	1.4	47 (D_c)	7.3	4.8	40 (D_c)
H	Isotopes	1.2	1.0	33 (D_c)	5.8	4.4	37 (D_c)
I	Isotopes	1.8	1.4	47 (D_c)	9.4	3.7	31 (D_c)
J	Isotopes	1.2	1.2	40 (D_c)	4.1	3.6	30 (D_c)
K	Chemistry	1.7	1.6	53 (D_c)	2.0	1.8	15 (D_c)
L	Isotopes	1.5	1.5	50 (D_c)	7.5	5.7	48 (D_c)
M	Isotopes	1.7	1.5	50 (D_c)	4.6	3.8	32 (D_c)

Note: Table 1 includes (1) all employees whose quarterly dose exceeded 5.0 rem for the skin (D_S) of the whole body or 1.0 rem for the total body (D_C), and (2) all employees whose dose for the year to date exceeds a D_S of 30.0 rem or a D_C of 12.0 rem. The MPD_Q is the maximum permissible dose allowed in a calendar quarter (13 weeks); the MPD_A is the maximum permissible dose allowed in a year.

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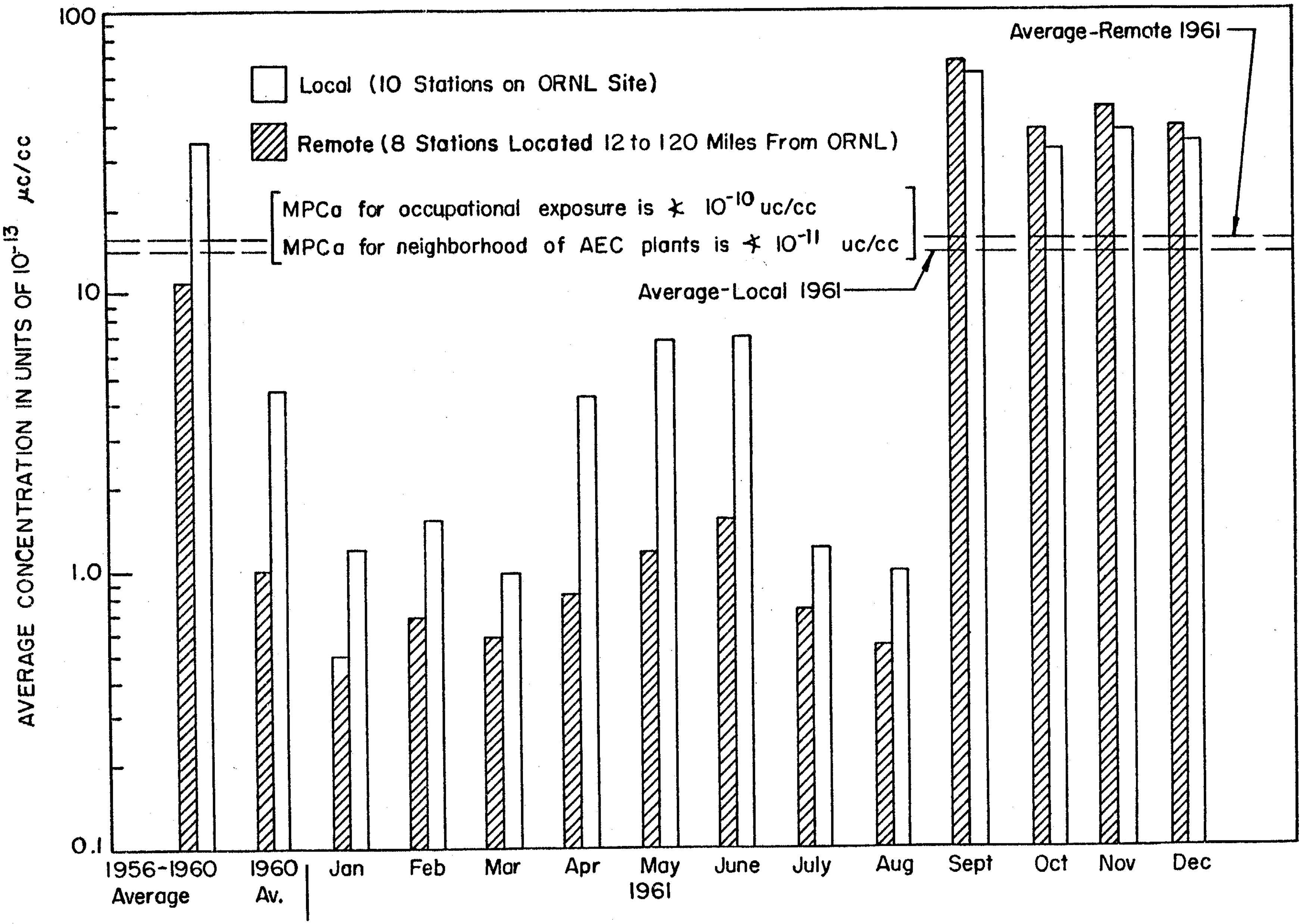

Fig 5.2 Airbone Radioactivity Measurements (Filter Paper Data)

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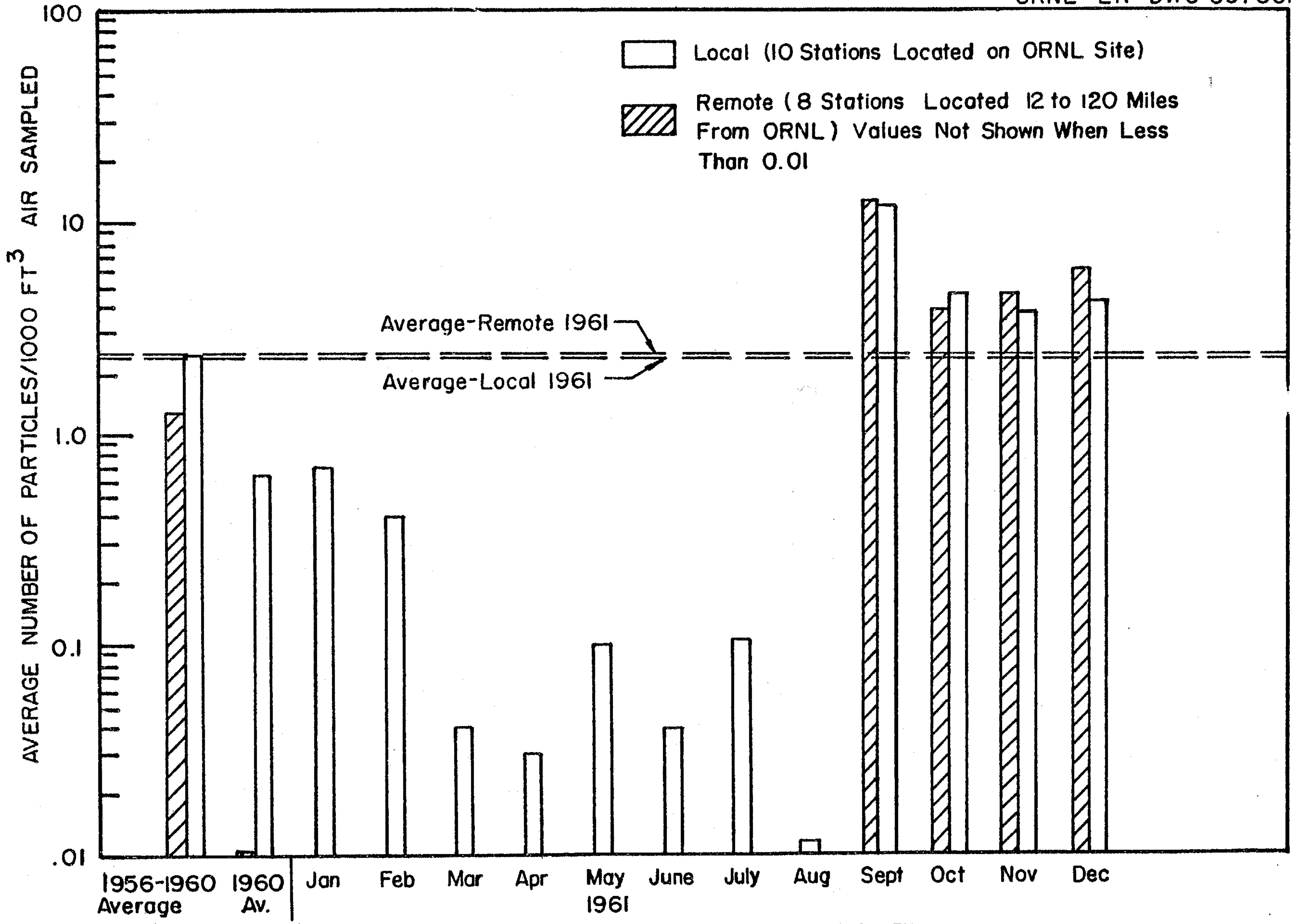

Fig. 5.3 Airborne Radioactive Particles Collected On Filters
(Measured by Autoradiographic Techniques)

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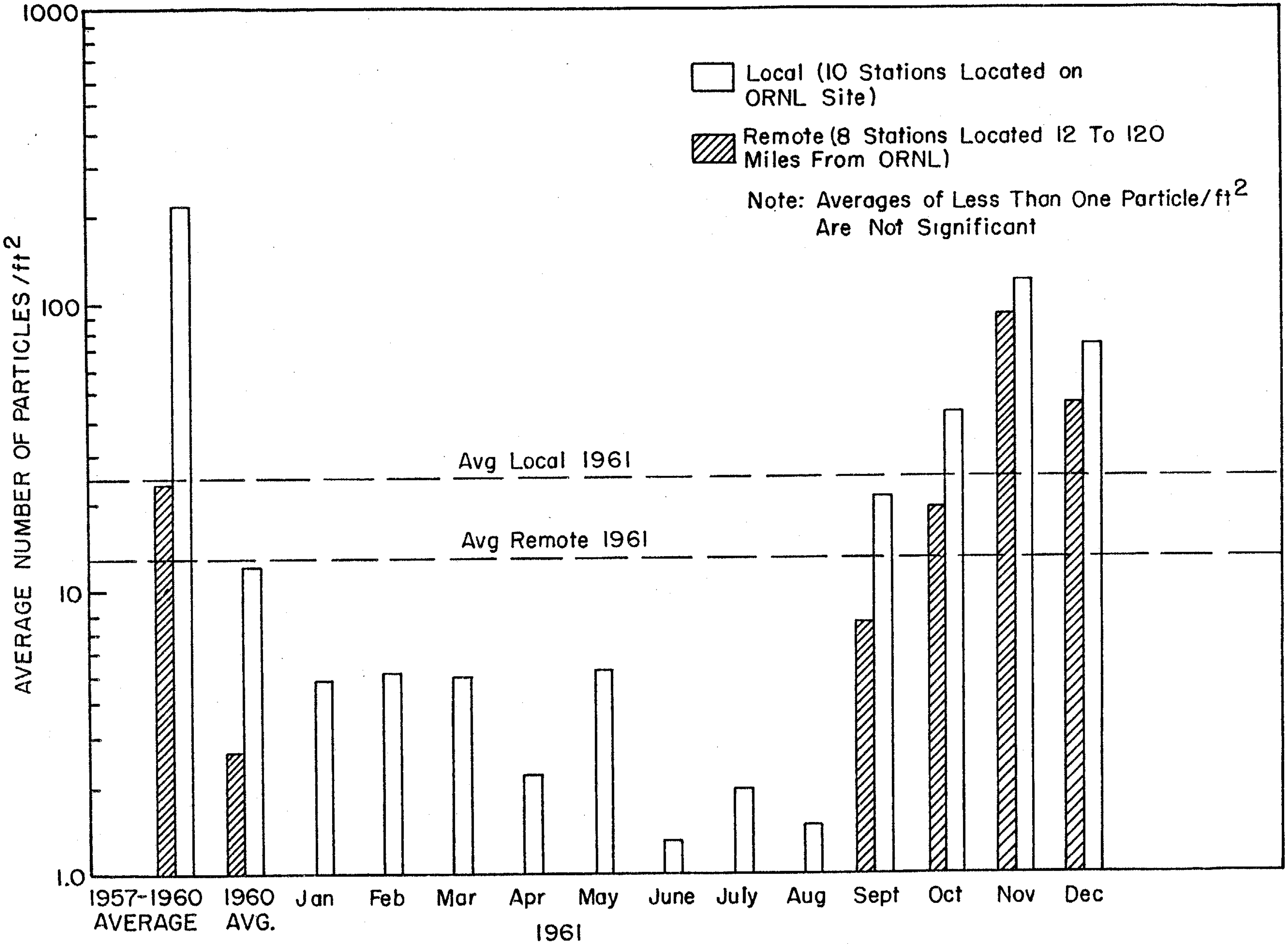

Fig. 5.4 Radioactive Particles Collected on Gummed Paper Trays (Measured by Autoradiographic Techniques)

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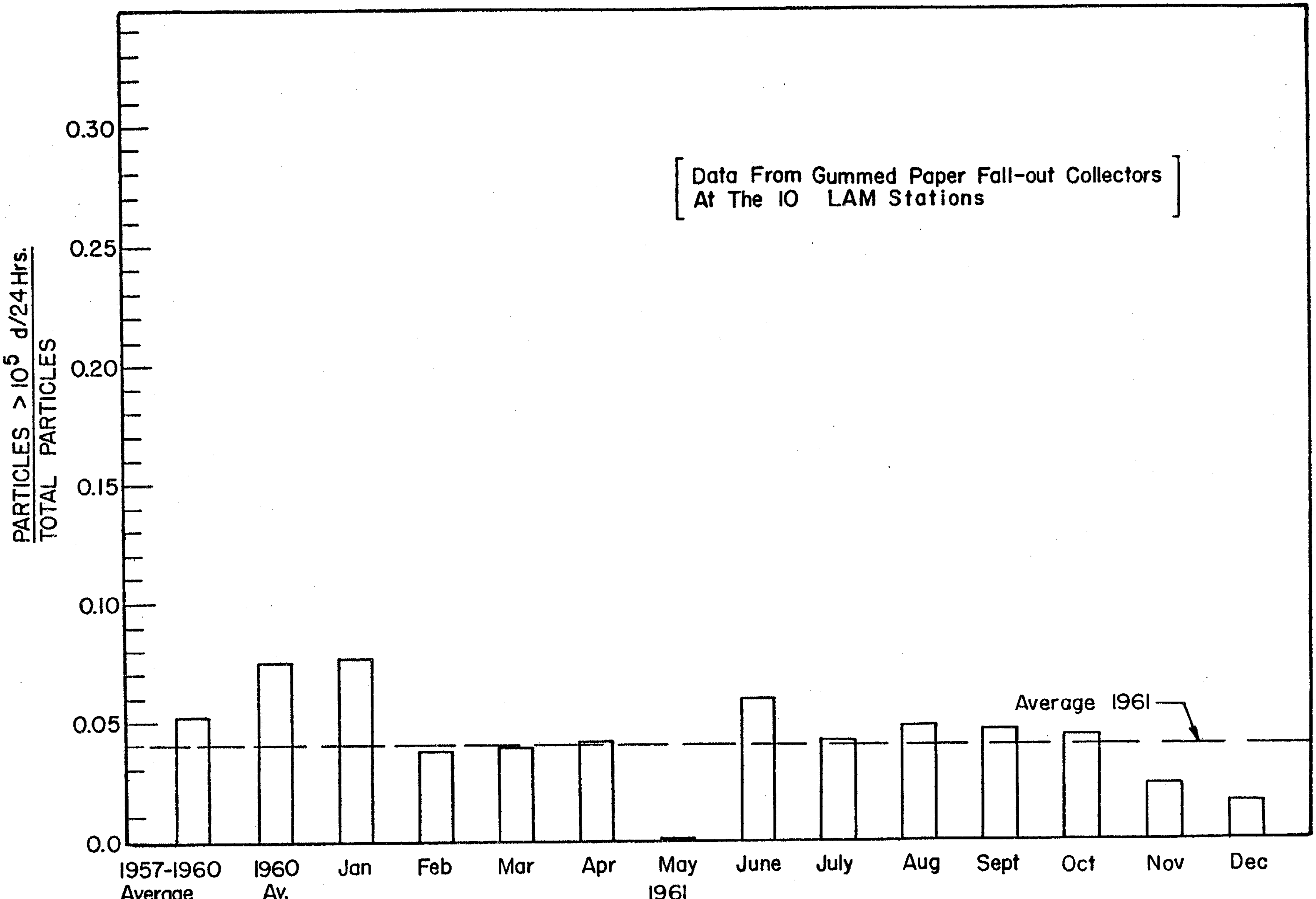

Fig. 5.5 The Ratio of Particles With Activity Greater Than 10^5 d/24 hrs. To The Total Number of Particles Collected.

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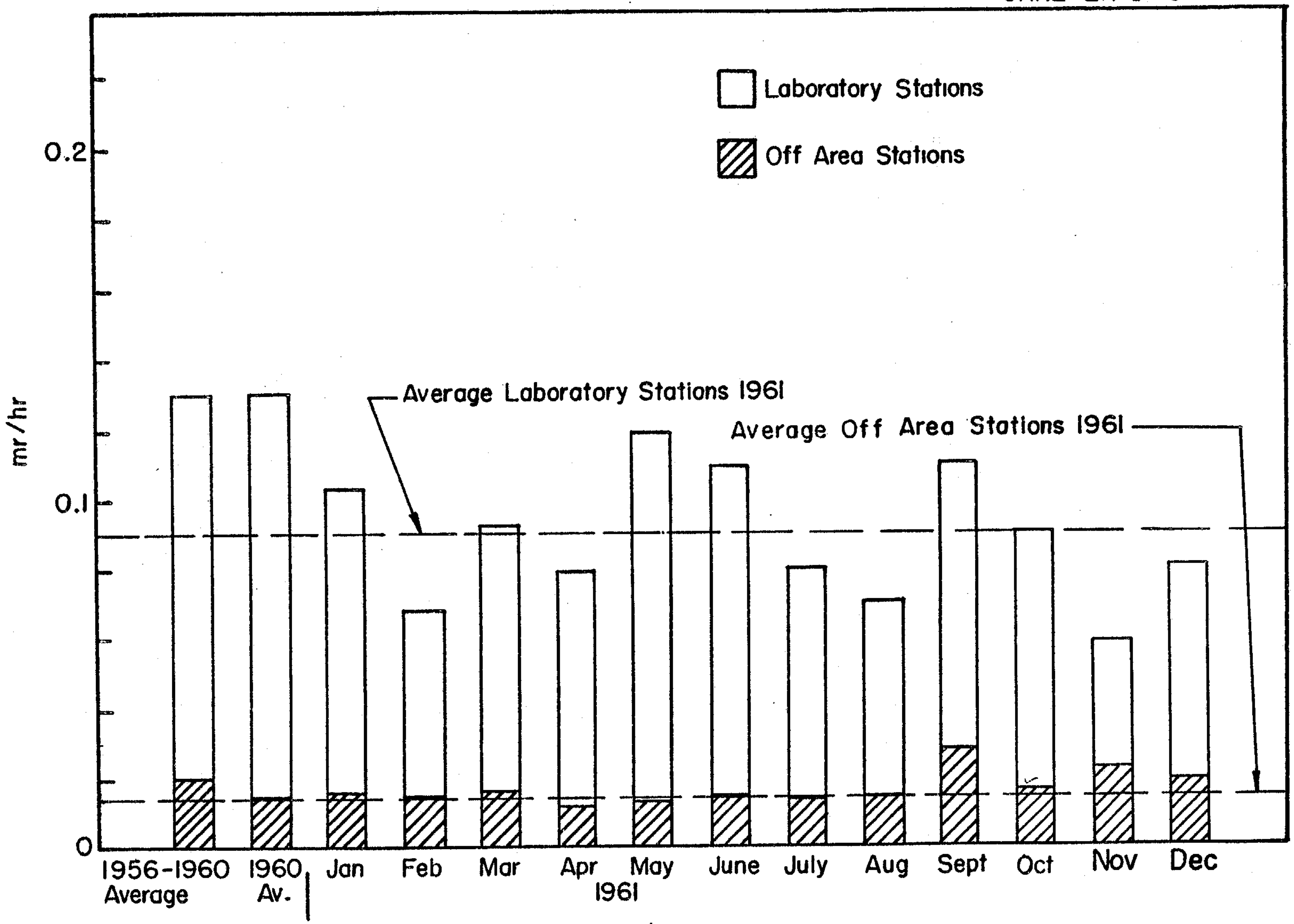

Fig. 5.6 Average Radioactivity Background Reading.

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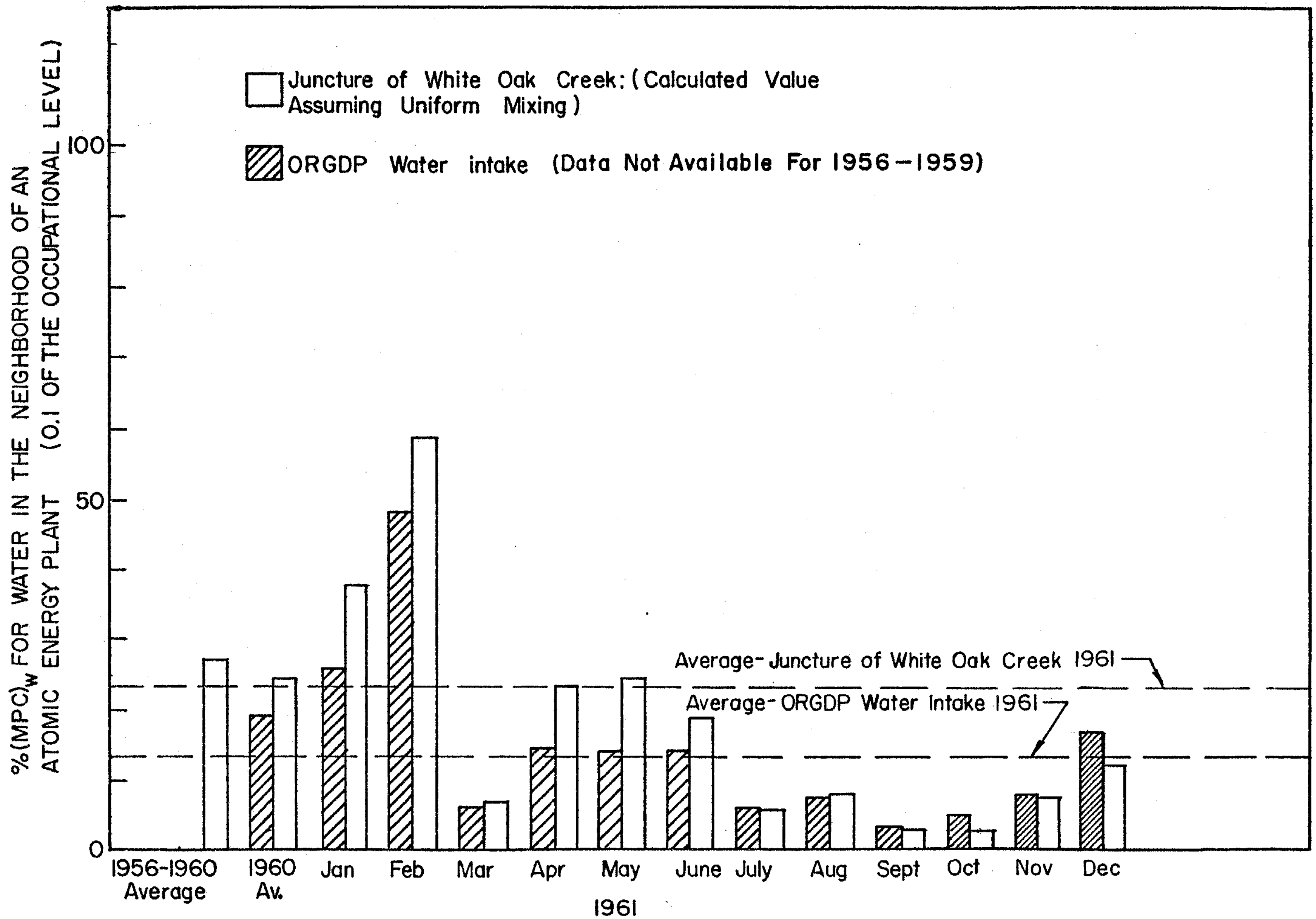

Fig. 5.7 Radioactivity Measurements in the Clinch River

6.0 APPENDIX

6.1 Whole Body Counting and Environmental Monitoring Activities of the Health Physics Technology Section - B. R. Fish, et al

Introduction

Most of the work of the Health Physics Technology Section is reported in the Health Physics Division Annual Progress Reports with detailed results presented in topical reports at the completion of each subproject. When the information developed is pertinent to the applied health physics program of the Division during a quarter, the data may be summarized for inclusion in the Applied Health Physics Quarterly Report.

Whole Body Counter[1] - (P. E. Brown, J. L. Thompson, S. A. Helf)

In the present routine program, an individual is counted for 20 minutes in the chair position using an 8" x 4" NaI (Tl) crystal located in a fixed geometry relative to the chair. During the calendar year 1961, 329 human counts were made: the maximum number of human counts in any one week was 51. A computer program, nearing completion, will permit automatic data processing of most routine human spectra and will allow a significant increase in the number of persons counted each week. The divisional distribution of the individuals counted is given in Table 1. Although 35 people were found to have measurable amounts of internal radioactive contamination, the highest indicated internal exposure during the year was < 20 per cent of the maximum permissible body burden and involved the radionuclide Hg^{203}.

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1 Health Physics Division Annual Progress Report, Period Ending July 31, 1961, ORNL-3189, pp. 222-224.

Radioactivity in Foods - (L. B. Farabee)

The data presented in Table 2 were obtained in connection with a study of methods for monitoring I^{131} contamination in the environment.[2] Sampling location "A" is in one of the prevailing wind directions and about ten miles from ORNL. Before the resumption of nuclear testing by the Soviet Union, milk samples collected in 1961 from all areas, including location "A", contained less than about 5 pc* I^{131} per liter (estimates based upon I^{131} on grass and in cattle thyroids); however, cattle thyroids ranged up to about 600 pc per thyroid in prevailing wind directions (very rare, i.e., one thyroid in several hundred); compared to an average background of about 30 pc per thyroid in areas remote from ORNL and other reactor installations. After the middle of September 1961, local fall-out from weapons tests reached a high and relatively constant level for several months. A certain individual consuming milk, eggs and leafy vegetables produced at location "A" was estimated to have ingested an average of about 150 pc of I^{131} per day. This daily intake remained nearly constant for about three weeks; then on October 18 the individual was counted in the ORNL whole body counter and was found to have 226 pc I^{131} in the thyroid.

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[2] Ibid, pp. 232-234.

* pc (picocurie) is equal to 1 micromicrocurie.

Table 1. NUMBER OF PERSONS EXAMINED BY WHOLE BODY COUNTING TECHNIQUES DURING THE CALENDAR YEAR 1961

Division	Year 1961 Number of Individuals		October - December 1961 Number of Individuals	
	Counted	Recounted	Counted	Recounted
Analytical Chemistry	7	1	-	-
Chemical Technology	65	11	2	-
Engineering and Maintenance	20	25	4	22
Electronuclear	1	-	-	-
Health Physics	68	9	12	3
Instrumentation and Controls	7	2	3	-
Isotopes	16	6	-	-
Metals and Ceramics	13	4	1	-
Neutron Physics	11	1	6	-
Operations	17	7	1	6
Physics	1	-	-	-
Reactor Division	9	-	-	-
Reactor Chemistry	5	-	1	-
REED	1	-	-	-
Solid State	1	-	-	-
Technical Information	2	-	-	-
Non-ORNL	11	8	6	7
Total Human Counts	329		74	

Table 2. Radioactivity in Foods – October–December 1961

Oak Ridge Area

Time	Sampling Station	Type of Sample	I^{131}	Total: $Sr^{90} + Sr^{89} + Ba^{140}$ pc/liter
During 18 months before Sept. 1960	(5 stations) Oak Ridge Area locations comparable to those below	Milk (10 samples)	–	Av 8.2 pc Sr^{90} (range 5.1–11.5) (no detectable Sr^{89} or Ba^{140})
Oct. 2	Station A	Milk	64 pc/l	18
Oct. 11	Station A	Milk	51	44*
		Eggs	4.2 pc/egg	–
Oct. 18	Station A	Turnip greens	<2.1 pc/gram	–
		Eggs	7.1 pc/egg	–
		Milk	55 pc/l	62*
Oct. 19	Station B	Milk	174	228*
	Dairy C	Milk	176	109*
Oct. 22	Station A	Eggs	4.6 pc/egg	–
Oct 25	Station A	Turnip greens	<3.6 pc/gram	–
		Milk	55 pc/l	96
Oct. 26	Station B	Milk	101	358*
	Dairy C	Milk	118	8 pc Sr^{90}; 126 pc Sr^{89}; 27 pc Ba^{140}
Nov. 2	Station A	Milk	27	6 pc Sr^{90}; 46 pc Sr^{89}; 12 pc Ba^{140}
	Dairy D	Milk	44	65
	Dairy E	Milk (past)	75	76
		(homo)	66	84
	Dairy F	Milk	31	77*
Nov. 9	Station A	Milk	29	26
Nov. 16	Station A	Milk	25	32
Nov. 30	Dairy C	Milk	50	215
Dec. 1	Dairy D	Milk	50	177*
Dec. 7	Dairy C	Milk	30	155*
Dec. 8	Dairy D	Milk	22	170*

*Decay studies on these 9 samples show an average radioactive half-life of 50.5 days (range 46.5 to 54.0 days) for the first two months. Strontium-89 (half-life 51 days) is the predominant radionuclide during the sampling period.

X-822

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62-5-65

COPY NO. 99

DATE: May 25, 1962

SUBJECT: APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY, FEBRUARY, AND MARCH OF 1962

TO: K. Z. Morgan - W. S. Snyder

FROM: J. C. Hart

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY, FEBRUARY, AND MARCH OF 1962

J. C. Hart, Section Chief

Data Contributed By:

H. H. Abee
T. J. Burnett
R. L. Clark
D. M. Davis
E. D. Gupton
L. C. Johnson
J. C. Ledbetter
O. D. Teague
A. D. Warden

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1.0 SUMMARY

During the quarter 20 Unusual Occurrences were recorded—all of which were classified as minor events. There were no personnel exposures which exceeded maximum permissible limits. The release of radioactive wastes to the Clinch River continued at a rate which resulted in concentrations that averaged well below the maximum permissible limits for drinking water. Radiation background readings were normal except for the continuing influence of radioactive fall-out originating from weapons testing and the air monitoring data continue to indicate that the release of radioactive materials to the atmosphere as the result of Laboratory operations remains well within maximum permissible limits.

2.0 UNUSUAL OCCURRENCES

Twenty Unusual Occurrences, all of which were classified[1] as minor events, were recorded during the first quarter and classified as follows: Nine events involved principally the contamination of personnel, equipment, laboratory surface areas or combinations of the three; two fires occurred involving minor amounts of radioactive materials; two events involved off-site assistance to the AEC-OROO; two separate events involving the Tower Shielding Facility and operations at Bldg. 9213 indicated a need for stronger administrative controls; three events involved external exposure to personnel; one minor wound involving potential contamination was treated at the dispensary; and a violation of a Laboratory regulation concerning on-site transfer of radioactive materials was reported.

1. While checking power lines that serve the Tower Shielding Facility (TSF), two employees approached within 1100 ft. of the TSF while the reactor was operating at 100 KW. At this point they observed the red warning lights and also noted that no personnel were to be seen outside the control house. Realizing the potential of the situation, the two employees decided to retreat from the area. At about the time they had started to leave, the fact that the employees were working within the 3000' line was brought to the attention of TSF supervision and steps were taken immediately to scram the reactor and warn the employees by announcement over the loud speaker system.

No significant personnel exposure was sustained; however, the occurrence should be placed in the "near miss" category due to circumstances surrounding the event.

Following the incident, and as a temporary measure, several more radiation danger signs were added to those already in place along the 3000' fence line. In addition, operating procedures covering work in

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[1] The method for classifying Unusual Occurrences is described in ORNL-3073, pp. 4-5.

the TSF area have been strengthened. (The erection of a positive exclusion type barrier around the TSF at the approximate 3000' range is getting underway.)

2. Two employees of the Y-12 Guard Department were in the vicinity of Bldg. 9213 at approximately the same time that a fast burst reactor unit was pulsed. Traveling in a vehicle provided by Bldg. 9213 supervision, two guards had left the guard post at Bldg. 9213 to rendezvous with a relief guard at a remote area post located some distance away. Ordinarily, the relief guard would have reported to the Bldg. 9213 post but, due to the time table for operating the reactor, it was decided that the two guards already on duty would depart for the remote area post in a company car and intercept the relief guard en route should he arrive prematurely. The relief guard, having advanced beyond the remote area post, failed to recognize the interception maneuver and proceeded on toward the Bldg. 9213 post. Immediately, one of the two guards returned with the car in pursuit of the relief guard while the second guard continued on foot to the remote area post to establish traffic control at that point. The relief guard was contacted and the two individuals returned to the remote area post in the vehicle driven by the relief guard. At approximately one minute after the reactor had pulsed, it was observed that the company car that had been issued to the two guards for transportation to the remote area post was parked at Bldg. 9213. The possibility of an exposure was considered and an immediate inquiry initiated.

A check of indium foil located in the (Y-12) badge meters worn by the guards indicated little or no induced activity. Film badges (processed by the Y-12 Health Physics group) indicated no significant exposure.

The significance of this occurrence lies in the potential for an exposure had the guards been in the immediate area at the time of pulsing of the reactor. More rigid controls over access to the Bldg. 9213 area during criticality experiments have been initiated.

3. A metal drum containing radioactive wastes being shipped to ORNL from the University of Michigan was discovered by personnel at the Huber and Huber trucking terminal to be slightly damaged and leaking. A survey made by Health Physics personnel indicated no detectable contamination from the leak. The radioactive material in the damaged drum was identified as consisting mostly of fission products, H-3, C-14, and P-32. The leaking drum was placed in two plastic bags and later disposed of at the ORNL burial ground.

4. Personnel and floor contamination occurred during the transfer to Bldg. 3038 of two special samples from the south demineralizer tank in the pipe tunnel located at the ORR. The problem was discovered when a Health Physics representative at the ORR noted an abnormal rise in background on a counter at the time that the samples were being carried from the pipe tunnel. A probe survey indicated readings up to 2 rad/hr with a paper chambered cutie pie at contact with the probe.

The two employees were contaminated on the hands, coveralls, and shoes. Maximum readings were: hands—1.5 mrad/hr; coveralls—15 mrad/hr; and shoes—3 mrad/hr. The highest pocket meter reading was 20 mr. Urinalysis indicated no significant internal exposure.

Floor contamination was confined to the vicinity of the pipe tunnel. The maximum reading observed was 20 mrad/hr and clean-up proceedings, started immediately, alleviated much of the problem.

To aid in preventing a recurrence of this nature, it was recommended that Health Physics surveillance be utilized for such work and that the procedure concerning "Transfer of Radioactive Materials within the Laboratory" be studied and followed.

5. On January 23, 1962, information was received from the Radiation Control Officer of the Neutron Physics Division that on December 7, 1961, a company pickup truck was sent from the TSF to the 7000 area garage for repairs, and that an unshielded PoBe source had been left unknowingly in the bed of the truck. The reason given by TSF supervision for not reporting the incident immediately was the improbability of a significant exposure to garage personnel. (The source was calculated to be reading 2.8 mrem/hr at 2.85 meters.)

Neutron films worn by the mechanic and garage foreman were processed and indicated no neutron exposure. Also, no significant exposure was indicated on the beta-gamma film.

The above occurrence indicates a need for the strengthening of administrative practices in two areas: First, vehicles used in the transportation of radioactive materials should be checked by a Health Physics representative prior to their release for maintenance or reassignment to another division; second, source material should be inventoried carefully and persons required to show accountability for sources on a somewhat frequent basis.

6. A fan motor in the attic of Bldg. 3550 servicing a hood in Lab 34 overheated and caught fire, necessitating a shutdown of the equipment.

Subsequent investigation revealed that, at the time of the fire, the hood was being used for storage of beakers, bottles, and assorted equipment but was not being used for work with radioactive materials. However, the hood was contaminated from previous operations yielding contamination levels up to 1.2×10^3 d/m β. Several air samples taken in the room indicated no significant air-borne contamination.

Analysis of urine specimens submitted by personnel working in the vicinity during the occurrence indicated no significant internal exposure.

7. At the request of the AEC-ORO office, an off-site response was made to check a burning loaded trailer located one mile east of Knoxville

on Highway 11-W. The trailer load included a consignment of pipe being transported to an Oak Ridge contractor. A "dangerous" label placarded on the side of the trailer alerted the state highway patrol to call the AEC-OROO. There were no radioactive materials involved. A "danger" sign and the Oak Ridge destination initiated the "alert" and subsequent response.

8. After completing the job of opening a process floor drain in the cell access area of Bldg. 3025, a water hose was inserted into the drain line and allowed to flow at line pressure for 45 minutes as a flushing action. This procedure caused contaminated water to back up through two floor drains carrying contamination to the east hallway and into two offices. A survey indicated general contamination on the floor up to 7.5×10^4 β d/m/100 cm^2 and 40 α d/m/100 cm^2. The areas were cleaned to permissible levels without difficulty. Personnel involved in clean-up operations indicated no significant internal exposure.

The back up was generally determined to be due to the insufficient capacity of the drain lines to handle the flow used in the flushing operation. Future operations of this nature should be monitored carefully where the drain-off capacity is unknown.

9. An employee was engaged in the effort of aligning and focusing a beam of deuterons from the Cockcroft-Walton accelerator located in the north end of Bldg. 3010 (BSF). Due to the fact that previous operations had contaminated the beam tube from a tritium target, the operation was giving rise to d-t neutrons whenever the deuteron beam interacted with the tritium contamination. Recognizing the unusual readings connected with the operation, the employee requested a Health Physics survey. The survey revealed readings of approximately 50 mrem/hr with the beam tube closed and approximately 300 mrem/hr with the beam tube open.

Due to an oversight, the employee did not have his film badge and pocket meters on his person. A reconstruction of the circumstance indicated that his exposure would not have exceeded 100 mrem.

Supervision responsible for the operation of this equipment has installed a "long counter" neutron monitor in the target room to prevent a recurrence of this nature following cross-contamination. The proper use of personal metering equipment has been stressed.

10. An employee sustained a cut on the right arm while placing a FPDL cask on the cask conveyor located behind the HRLAF storage cell. The employee was attempting to retrieve a plastic bag which was slipping off the cask when the cask swayed, pinning his arm against a motor support. Although a survey of the motor support showed contamination of approximately 3×10^4 β d/m, no contamination was detected at the site of the wound.

11. The removal of five sample carriers containing HRE fuel product samples from Cell 15, Bldg. 3517, resulted in contamination at the

second working level of the area. Direct readings indicated certain spots contaminated up to 2 mr/hr. Transferable contamination up to 1.2×10^5 d/m β was detected. Decontamination with soap and water moppings was effective.

12. An X-ray exposure was sustained by an employee as he sighted through the port of a high temperature diffraction camera to see if a thermocouple was properly aligned. The employee was not aware that the port was open when he was inspecting the thermocouple alignment. The X-ray unit was operating at 35 KV with a tube current of 20 ma.

A low energy chamber Victoreen r-meter was used to measure the dose from the exit port of the diffraction camera. The measured dose was approximately 5 r/sec at the estimated position of the employee's eye; however, the employee was wearing spectacles at the time of the exposure and the intensity of the beam shielded by the spectacles was measured at approximately 1.3 mr/sec. The dose to the employee's eye was estimated to be less than 10 mrem. However, a small portion of the skin of the face may have received a dose of several rem, although there has been no clinical evidence to indicate a reaction on the skin.

This exposure resulted because personnel failed to follow established operating procedures. The safe operation of this type X-ray equipment, to a large extent, depends upon the caution exercised by the operators in following approved operating techniques. As the result of this occurrence, steps are underway to install safety interlocks and warning devices insofar as is feasible on all X-ray equipment located at the Laboratory. In addition, special training sessions for employees and supervisors responsible for this type of equipment are underway.

13. As an employee was injecting mice with a saline solution containing one μc of I-131 per ml, the needle became loose at the syringe, allowing some of the solution to spray on his face. It was estimated that approximately 0.5 ml may have been released from the syringe. He washed his face immediately. No contamination was found on the employee or the surrounding laboratory area. A thyroid count indicated no significant intake of the material and urinalysis indicated no significant internal exposure.

14. An employee was running water over a glass column in a fission products cell in Bldg. 3028E when he observed that the floor drain was plugged and the water had overflowed through the air lock at the door of the cell.

A preliminary survey indicated readings up to 8 rad/hr at 3" from the main pool of liquid near the cell door. Approximately 65 square feet of floor surface on the southeast side of the cell was involved. Immediate decontamination efforts were successful to the point of allowing resumption of work in the area under controlled conditions. No personnel contamination resulted; pocket meters worn by the one individual read up to 25 mr.

Plugged drains, or insufficient drainage line capacity, continues to receive insufficient attention. (See item #8.) Supervision must become alert to the potential of this type of failure in facility equipment.

15. Personnel and area contamination occurred in Bldg. 3517 when a chemical operator, operating the panel board at Cell 11, attempted to jet solution from one tank into another tank. The operator noticed that the transfer of solution was not taking place as it should and proceeded to turn off the jet valve. Then, when the valve was closed, approximately 75 ml of solution came out around the valve as the result of internal pressure. (The principal component in the ejected material was identified as Cs-137.)

A thorough probe and smear survey of the building indicated that most of the contamination was confined to the first level south area. The maximum reading obtained was 900 mrad/hr at 2" from the surface on the floor south of Cell 11. Decontamination of the area was started immediately and included chipping out an area of approximately 3' x 5' on the floor directly under panel board #11.

A survey of personnel indicated that the employee operating the panel board had contaminated his left hand to approximately 20 mrad/hr. Nasal smears taken on three employees indicated maximum reading of 10^4 d/m β,γ. The hand and nasal contamination problems were handled without difficulty.

Analysis of the urine specimens indicated no significant internal exposure, and a whole body count of the panel board operator indicated no significant body burden of gamma-emitting radioactive materials. The highest reading recorded by pocket meters was 5 mr.

16. Personnel and area contamination occurred in Bldg. 3517 when an estimated 250 ml of solution escaped from an air line leading to a valve on one of the tank jets. An area, approximately 3' square on the floor inside Cell 11 panel board, was contaminated to 10 rad/hr measured 6" from the floor. (What happened to cause this contamination problem has not been established definitely at this time. However, the solution in the line may be traced to the Unusual Occurrence described in #15 above.)

The chemical operator on duty was contaminated, requiring a shower and hand decontamination. Pocket meters worn by the operator recorded readings of approximately 20 mr. Urinalysis indicated no significant internal exposure.

Decontamination of the area was started immediately and continued until the transferable surface activity was less than 500 d/m β.

17. During a routine survey, spots on the floor of Room 32, Bldg. 3550, were found to be contaminated with powder-like fission products. It is believed that the contamination was spread by a fan-heater which hangs

from the ceiling of the room as it is known that the fan causes air turbulence in the hood when the heater baffles are located in certain positions.

The highest reading obtained on the initial survey was 20 mrad/hr at 1" from the floor surface. A smear survey indicated transferable contamination up to 3×10^3 d/m β. Decontamination efforts were completed successfully with soap and water washes.

Urine specimens submitted by employees working in the room indicated no significant internal exposure.

In order to prevent a recurrence, steps are underway to adjust the heater baffles properly and fasten them in a fixed position.

18. A fire occurred in the filters of the ventilation system that services the Y-12 beryllium shop, Bldg. 9766. As the result of the fire, some smoke entered the ceramics laboratory (staffed by ORNL Metals and Ceramics Division personnel). The filter system was in use during the grinding of uranium carbide and there was some history involving the machining of thorium billets.

The Y-12 Industrial Hygiene Unit investigated the possibilities of a beryllium hazard and reported that no significant problem existed.

A survey in the ceramics laboratory indicated low level alpha contamination that might be expected from the routine work with uranium and thorium oxides performed there.

Analysis of urine specimens submitted by personnel working in the area indicated no significant internal exposure.

19. Materials that had been used for decontaminating Cell 1, Bldg. 3517, were being transferred to a "yellow" dumpster located outside the building when a leak was observed in the double plastic bag container carried by two employees. The leak left a narrow path of contamination reading up to 20 mrad/hr at 2" on the black top surface between the building and the dumpster. Decontamination efforts were effective in reducing the contamination to acceptable limits.

This occurrence points up the necessity for prior planning in transferring materials of this nature and in utilizing effective containment.

20. While preparing Am-241 for shipment, utilizing a glove box located in Bldg. 3032, an employee received an estimated exposure of 10 rem to the tips of his fingers with a measured dose of 4 rem to the area where hand meters were worn. This exposure represents 40% of the quarterly permissible dose to the hands as defined by the Federal Radiation Council. The employee's pocket meters recorded readings of approximately 75 mr.

It is understood that in the future this operation will be performed in Bldg. 9204-3, Y-12, under conditions providing appropriate shielding.

3.0 PERSONNEL MONITORING

3.1 External Dose Measurements

The highest whole body exposure recorded during the quarter (see Table 5.1) was 1.8 rem which represents 60% of the maximum permissible quarterly dose (MPD_Q). The second highest exposure sustained by an employee in this category was 57% of the MPD_Q or about 1.7 rem. The highest whole body skin dose recorded during the quarter was 6.0 rem which is 60% of the MPD_Q[2] for this type of exposure. The second highest whole body skin dose was 3.7 rem, or 37% of the MPD_Q.

3.2 Internal Dose Measurements

At the conclusion of the first quarter, three employees continued to show an estimated bone burden of Pu-239 in excess of 30 per cent[3] of the maximum permissible level as determined from urinalysis by currently established methods. These employees have submitted urine samples routinely over the past several months and there is continued evidence that the deposition of Pu-239 in the bone will not exceed approximately 1/3 of the maximum permissible body burden.

4.0 ENVIRONMENTAL MONITORING

4.1 Air-borne Radioparticulate Measurements

The average concentration of radioparticulate matter collected on filters from air sampled at the ten LAM[4] stations was 4.0×10^{-12} μc/cc. Assuming a maximum permissible occupational exposure of 10^{-9} μc/cc, the above concentration represents 0.4 per cent of the maximum permissible concentration, $(MPC)_a$, for occupational exposure[5]. The average concentration observed at the seven PAM[6] and seven RAM[7] stations was 3.9×10^{-12} μc/cc and 4.8×10^{-12} μc/cc respectively. Although the average

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[2] The MPD_Q established by the FRC for the skin of the whole body is 10 rem.

[3] The action point for curtailing an employee's exposure to internal emitters.

[4] LAM - Local Air Monitor located at or near the X-10 site.

[5] Defined in NBS Handbook 69.

[6] PAM - Perimeter Air Monitor located on the outer boundary of AEC-controlled area.

[7] RAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

levels observed at all three monitoring networks do not differ significantly, the levels recorded by the PAM and RAM networks represent about 4 to 5 per cent of the $(MPC)_a$ for the neighborhood surrounding a controlled area[5]. The concentration of air-borne radioparticulate matter continues to average levels which approach two orders of magnitude above the average levels recorded just prior to the resumption of nuclear testing in September of 1961 (see Fig. 6.1) and there appears to be only slight variations in the fall-out picture when examined on a week by week basis by these methods (see Table 5.2).

4.2 Rain Water Analyses

The average concentration of radioactive materials dispersed in rain water collected at the LAM stations was 1.4×10^{-6} μc/cc. The average level for both the PAM and RAM stations was 1.6×10^{-6} μc/cc. Assuming for occupational exposure a maximum permissible concentration of 3.0×10^{-5} μc/cc for an unidentified mixture of radionuclides in water[5], the concentration observed in rain water collected at the LAM stations represents 4.7% of the maximum permissible concentration, $(MPCU)_w$, for drinking water. The corresponding value for persons living in the neighborhood of a controlled area (non-occupational = 1/10 of the occupational exposure value) was about 53% of the $(MPCU)_w$. The values recorded for each collection station are shown in Table 5.3. A comparison between the values recorded during the first quarter of 1962 with the four previous years is shown in Fig. 6.2.

4.3 Gummed Paper Fall-Out Collectors

A sharp decrease in the average number of radioparticulates collected by the gummed paper technique[8] was observed to have begun around the end of January during the first quarter (see Table 5.4). The average observed during February and March was about 1/25 of the value recorded for the month of January. Following the resumption of weapons testing, a rapid increase in fall-out was observed with the highest average occurring during November of 1961 (see Fig. 6.3). The average observed during the entire first quarter of 1962 was about 1/4 of the November average.

4.4 Clinch River Data

The calculated average concentration of radioactive materials in the Clinch River at Mile 20.8 (junction of White Oak Creek with Clinch River) was 0.45×10^{-6} μc/cc (see Table 5.5). The measured average concentration at Mile 14.5 (near ORGDP) was 0.34×10^{-6} μc/cc. These levels, when evaluated on the basis of the radionuclide mixture observed at the point of measurement, represent 8.5% and 13.9% of the maximum permissible concentration $(MPC)_w$ for drinking water for individuals

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[8] The gummed paper technique utilizes a thin sheet of plastic covered with a "sticky" substance that presents a collection surface of 1 sq. ft.

living in the neighborhood of a controlled area[5]. The per cent $(MPC)_w$ for the first quarter of 1962 does not differ greatly from the average level observed during 1961 (see Fig. 6.4).

4.5 Background Measurements of Ionizing Radiation

The average background level for the 53 stations located on the Laboratory site was 0.084 mr/hr. The average level for the five stations located off-site around the perimeter of the controlled area was 0.026 mr/hr. Only normal variations in background were observed (see Table 5.6) and the averages for the quarter are comparable with the yearly averages observed since 1958 (see Fig. 6.5).

5.0 TABLES

Table 5.1 Personnel Monitoring Exposure Resume—1st Q, 1962

Employee	Division	First Quarter Dose (rem) D_s	D_c	% MPD_Q	Cumulative Dose for 1962 (rem) D_s	D_c	% MPD_A
A	Isotopes	6.0	1.0	60	6.0	1.0	20
B	Isotopes	2.8	1.8	60	2.8	1.8	15
C	Isotopes	2.0	1.7	57	2.0	1.7	14
D	Isotopes	2.2	1.6	53	2.2	1.6	13
E	Chem. Tech.	3.7	1.4	47	3.7	1.4	12
F	Isotopes	1.6	1.4	47	1.6	1.4	12
G	Health Physics	1.6	1.4	47	1.6	1.4	12
H	Isotopes	1.4	1.4	47	1.4	1.4	12
I	Isotopes	2.6	1.3	43	2.6	1.3	11
J	Anal. Chem.	3.8	0.5	38	3.8	0.5	13
K	Biology	1.6	1.1	37	1.6	1.1	9
L	Chem. Tech.	1.2	1.1	37	1.2	1.1	9
M	Chem. Tech.	2.3	1.0	33	2.3	1.0	8
N	Isotopes	1.5	1.0	33	1.5	1.0	8

Note: Table 5.1 includes a breakdown of exposures for employees where a dose exceeds approximately 1/3 of the MPE as follows: (1) employees whose quarterly dose exceeded 3.0 rem for the skin of the whole body (D_s) or 1.0 rem for the total body (D_c), and/or (2) employees whose dose for the year to date exceeds a D_s of 10.0 rem or a D_c of 4.0 rem.

Table 5.2 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—1st Q, 1962

Week No.	LAM Network	PAM Network	RAM Network
1	3.3×10^{-12} μc/cc	3.7×10^{-12} μc/cc	4.9×10^{-12} μc/cc
2	3.2	3.0	4.0
3	3.6	3.3	4.3
4	3.8	3.3	3.4
5	5.1	4.7	6.2
6	6.3	6.3	7.9
7	3.3	3.3	4.1
8	3.1	2.9	3.8
9	3.6	3.6	4.4
10	2.8	2.5	3.2
11	3.8	4.0	4.6
12	4.4	4.2	5.1
13	5.2	5.5	6.5
Quarterly Average	4.0×10^{-12} μc/cc	3.9×10^{-12} μc/cc	4.8×10^{-12} μc/cc

Table 5.3 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—1st Q, 1962

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	1.4×10^{-6} μc/cc
	PAM Network	
HP-31	Kerr Hollow Gate	1.7×10^{-6} μc/cc
HP-32	Midway Gate	1.5
HP-33	Gallaher Gate	1.4
HP-34	White Oak Dam	2.0
HP-35	Blair Gate	1.4
HP-36	Turnpike Gate	1.4
HP-37	Hickory Creek Bend	1.8
Network Average		1.6×10^{-6} μc/cc
	RAM Network	
HP-51	Norris Dam	2.1×10^{-6} μc/cc
HP-52	Loudoun Dam	1.5
HP-53	Douglas Dam	1.5
HP-54	Cherokee Dam	1.2
HP-55	Watts Bar Dam	1.9
HP-56	Great Falls Dam	2.0
HP-57	Dale Hollow Dam	1.4
Network Average		1.6×10^{-6} μc/cc

Table 5.4 Radioparticulate Fall-Out Measurements Averaged Weekly from Gummed Paper Data—1st Q, 1962

Week Number	LAM Network	PAM Network	RAM Network
1	83 particles/ft^2	76 particles/ft^2	66 particles/ft^2
2	42	40	31
3	46	52	26
4	123	149	119
5	3	3	1
6	53	58	47
7	28	25	9
8	33	35	26
9	34	34	21
10	35	38	22
11	13	7	6
12	66	84	80
13	38	30	20
Quarterly Average	46 particles/ft^2	49 particles/ft^2	36 particles/ft^2

Table 5.5 Concentration of Radioactive Materials in the Clinch River—1st Q, 1962

Location	Radionuclides of Primary Concern (Units of 10^{-8} μc/cc) Sr^{90}	Ce^{144}	Cs^{137}	$Ru^{103-106}$	Co^{60}	Average Concentration of Total Radioactivity 10^{-6} μc/cc	$(MPC)_w^a$ 10^{-6} μc/cc	% $(MPC)_w$
Clinch River Mile 20.8	0.1	0.01	0.08	13	0.23	0.45	5.5	8.5

[a] Weighted average $(MPC)_W$ calculated for the mixture using $(MPC)_W$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.6 Background Measurements of Ionizing Radiation—1st Q, 1962

Area	Monthly Average for All Stations (mr/hr) January	February	March	Quarterly Average for All Stations (mr/hr)
Laboratory Site (53 stations)	0.075	0.100	0.076	0.084
Off-Site (5 stations)	0.024	0.022	0.031	0.026

Note: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mr/hr.

6.0 FIGURES

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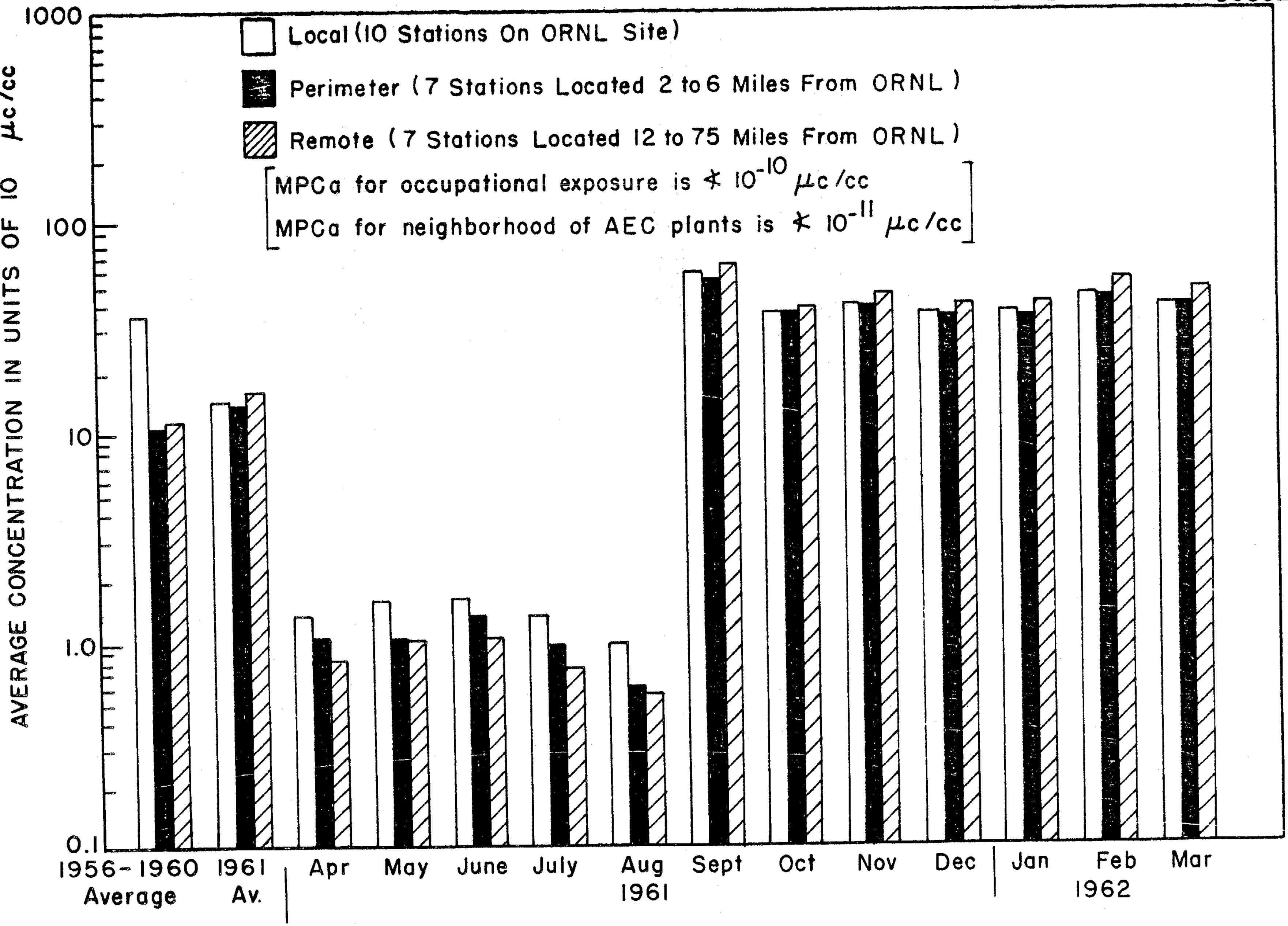

Fig. 6.1 Concentration Of Radioactive Materials In Air
(Filter Paper Data)

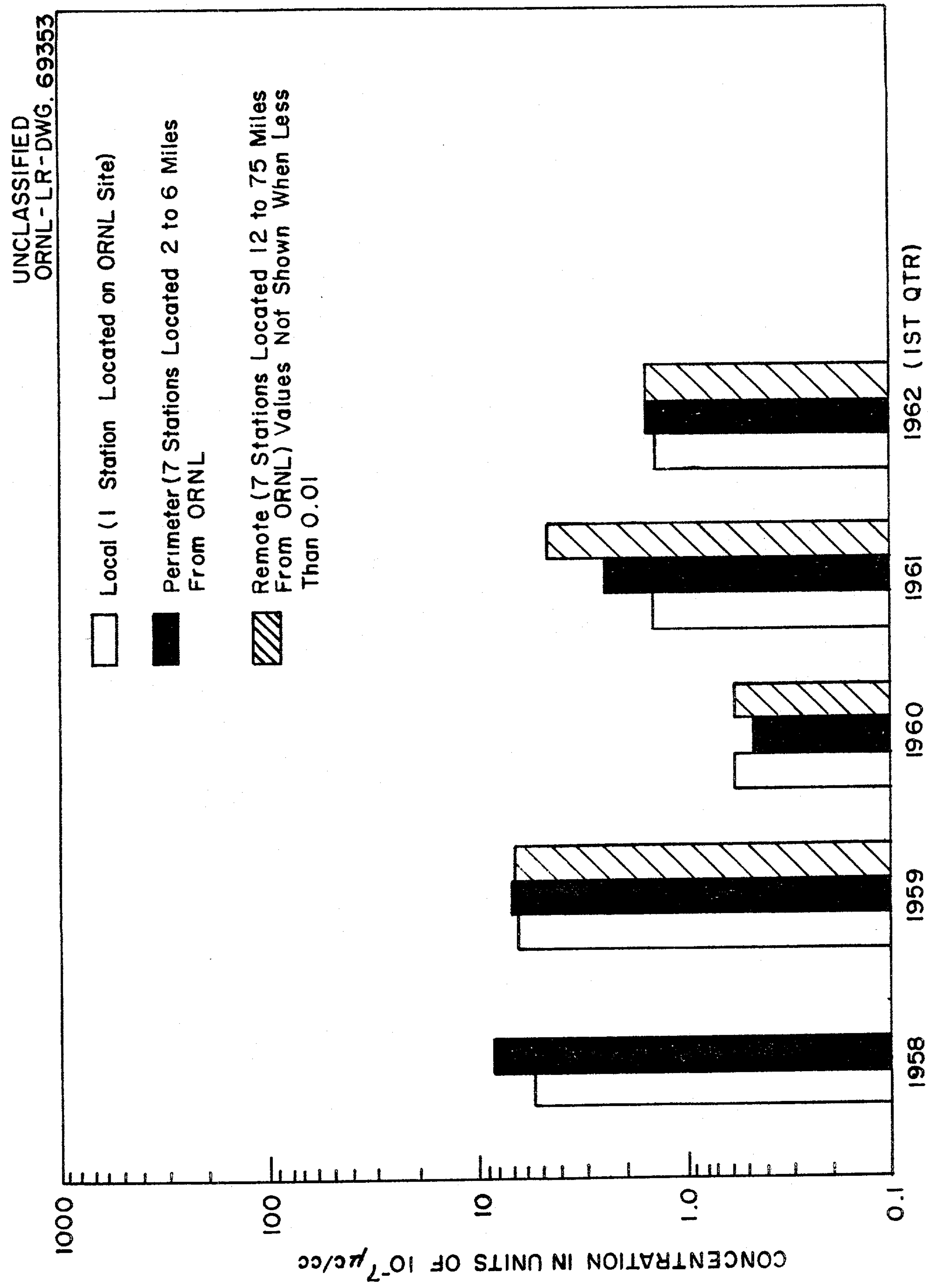

Fig. 6.2 Concentration Of Radioactive Materials In Rain Water

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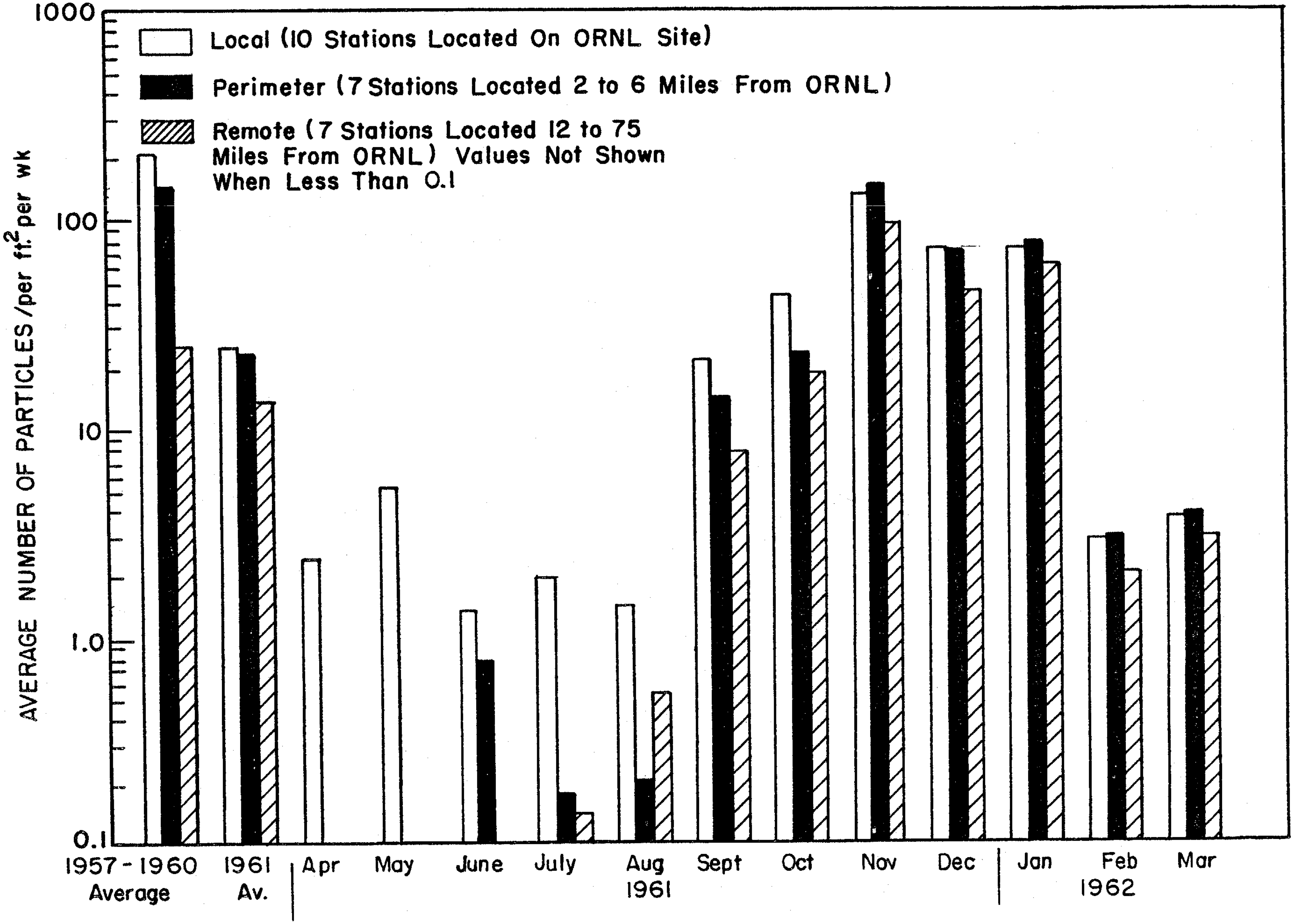

Fig. 6.3 Radioparticulate Fall-Out Measurements (Measured By Autoradiographic Techniques Using Gummed Paper Collectors)

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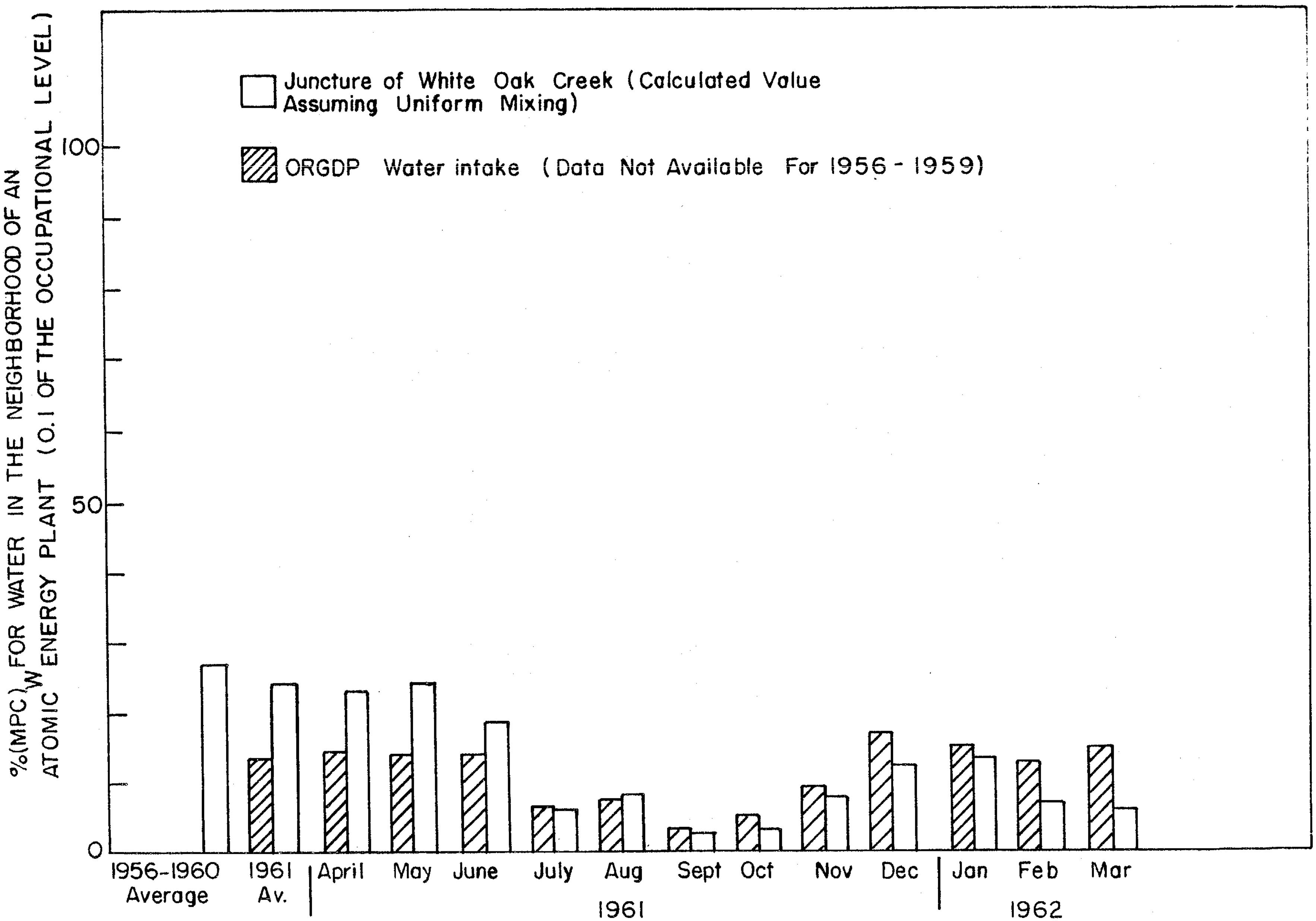

Fig. 6.4 Radioactive Content Of Clinch River Water

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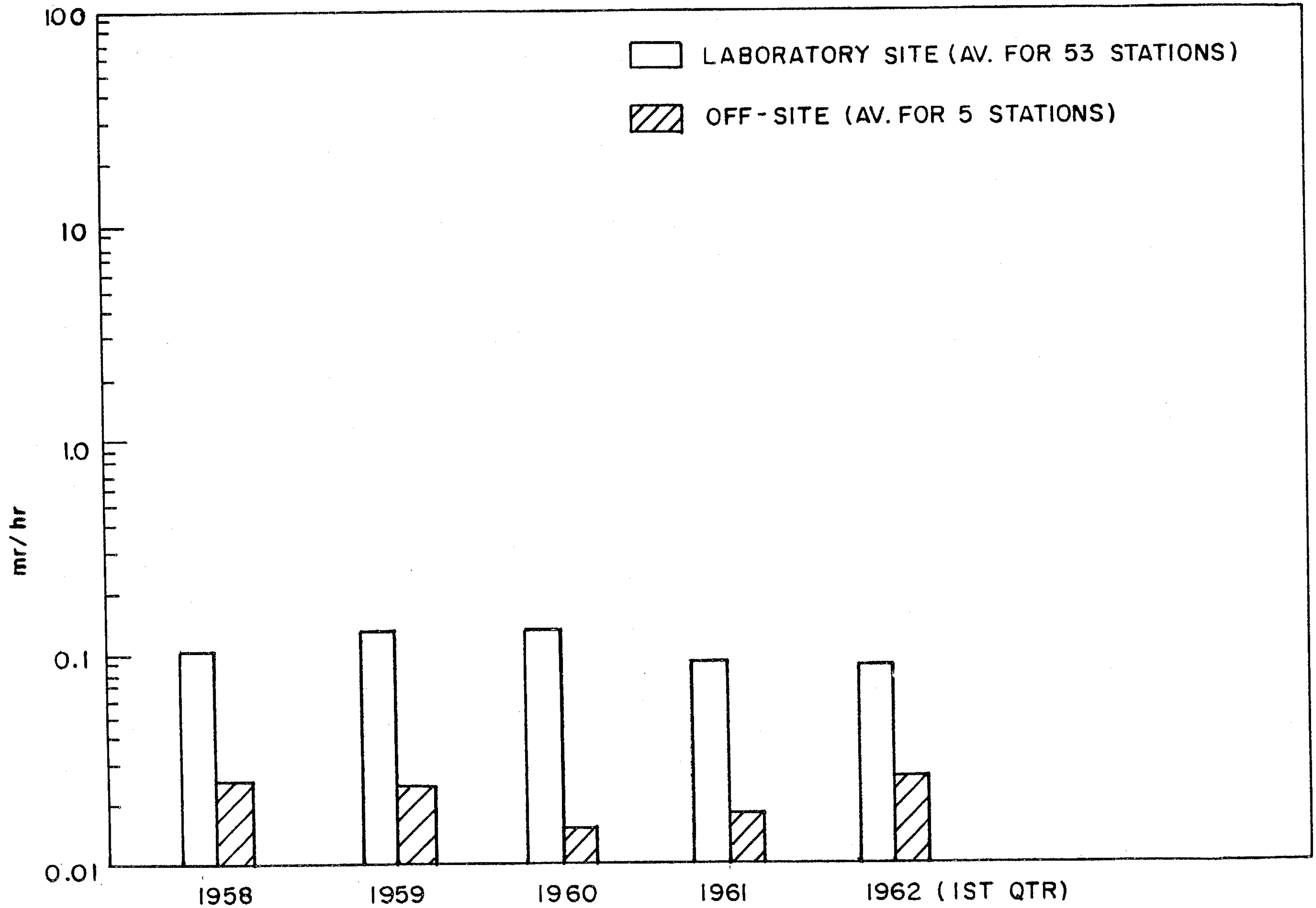

Fig. 6.5 Background Measurements Of Ionizing Radiation

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DATE: August 31, 1962

SUBJECT: APPLIED HEALTH PHYSICS QUARTERLY REPORT - APRIL, MAY, AND JUNE OF 1962

TO: K. Z. Morgan - W. S. Snyder

FROM: J. C. Hart

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HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - APRIL, MAY, AND JUNE OF 1962

J. C. Hart, Section Chief

Data Contributed By:

H. H. Abee
T. J. Burnett
R. L. Clark
D. M. Davis
E. D. Gupton
L. C. Johnson
J. C. Ledbetter
O. D. Teague
A. D. Warden

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1.0 SUMMARY

1.1 Unusual Occurrences - 14. (The number for the first quarter of 1962 was 20 and the average for 1961 was 19.)

1.2 Personnel Exposures - Only 13 exposures equalled or exceeded 1/3 of the maximum permissible quarterly dose. Of these, five were experienced in the Isotopes Division, five in the Chemical Technology Division, and one each in the Analytical Chemistry, Engineering and Mechanical, and Health Physics Divisions. No exposure exceeded 57 per cent of the maximum permissible limits.

1.3 Air-Borne Radioparticulate Measurements - Air-borne radioparticulate matter collected by the LAM network in the Laboratory area averaged 4.5×10^{-12} μc/cc during the quarter. The average value determined from data generated by the PAM and RAM networks was 5.0×10^{-12} μc/cc. The above values indicate that Laboratory operations did not contribute significantly to the air contamination levels recorded throughout the East Tennessee area.

1.4 Water Monitoring - Clinch River water sampled at ORGDP (CRM 14.5) averaged 12.4% of $(MPC)_w$ for the neighborhood of an atomic energy installation.

1.5 Background Radiation - 0.096 mr/hr average at ORNL; and 0.030 mr/hr average off-site. (The corresponding values for the 1st quarter of 1962 were 0.084 and 0.026 mr/hr respectively; the value recorded in the year 1943 for the East Tennessee area was approximately 0.012 mr/hr.)

2.0 UNUSUAL OCCURRENCES

There were 14 unusual occurrences, all classified as minor events[1], recorded during this period. Ten events involved the contamination of personnel; the remaining four events are separately categorized as (1) an air-borne contamination release in Bldg. 3019, (2) the contamination of an AEC trailer, (3) the contamination of a street in the Isotope Area, and (4) a minor wound involving potential contamination.

1. One Laboratory employee and two contractor employees became slightly contaminated when air-borne radioactivity (Ce-144 and Cs-137) was released during removal of a carrier from a cell in Bldg. 3029. Transferable contamination in the area was moderately severe as indicated by smears which read up to 10 mrad/hr. Decontamination of personnel and facilities was accomplished with minor effort.

Urinalyses and examinations in the whole body counter indicated no significant internal exposures. The maximum external exposure (from pocket meter data) was 105 mrad.

2. Contamination of protective clothing (up to 100 mrad/hr) and skin surfaces (up to 4 mrad/hr) of employees working in the east end of the

[1] The method for classifying unusual occurrences is described in ORNL-3073, pp. 4-5.

penthouse area at Bldg. 3019 resulted from a release of radioactive materials (Sb-125 and Ru-106) during the replacement of a fuel element into the hydrofluorinator in Cell 1. Readings up to 225 mrad/hr were obtained two inches away from surface area in the immediate vicinity of of the release.

Personnel evacuated the penthouse immediately following an alarm signal originating from a nearby CAM. Shower baths removed the contamination from personnel. Pocket meter data indicated no measurable external exposures. Excreta analyses and whole body counter techniques indicated no significant internal exposures.

Facility contamination was reduced to acceptable levels by water flushes. Equipment modification and/or procedural changes are to be made prior to any subsequent element charging operations in this area.

3. Contamination of the head and shoulders of an employee resulted when an empty sample holder dropped into solution present in the well of a transfer shield which was being dismantled. Multiple showers removed the contamination from the employee's head and shoulders; however, the assistance of the Health Division was required in decontaminating the hands to acceptable levels.

Urinalysis indicated no significant internal exposure.

4. The removal of two special isotope trays from the Graphite Reactor resulted in Np-239 contamination on the second level south up to approximately 10^5 d/m/100 cm^2. Nasal swabs taken from the six employees involved showed contamination up to 10^3 d/m. The decontamination of personnel and the work area was easily accomplished. There was no indication of significant internal exposure as determined by urinalyses and whole body counter examinations. The maximum external exposure as determined by pocket meter data was 10 mrad.

5. Air-borne contamination consisting primarily of Sb-125 and Ru-106 was released to the penthouse area of Bldg. 3019 when a temporary containment cover was removed from a ball valve unit located in an element charger assembly at the VPP. The cover was being removed by two employees preparatory to the installation of a vent line when an alarm signal from a nearby CAM sounded. Upon hearing the alarm signal, the employees replaced the cover immediately with the result that extensive contamination of the area was avoided. A personnel survey indicated no significant personnel contamination.

6. Surface areas on the second level south of Bldg. 3001 were contaminated during decontamination proceedings involving Hole # 4 of the Graphite Reactor. Direct readings up to 75 mrad/hr were found during a survey of floor surfaces. Some contamination was detected on clothing worn by the operators in the area.

Pocket meter readings indicated the maximum external exposure to be approximately 10 mrad; urinalyses showed no evidence of significant internal exposure.

7. A laceration of the middle finger of the left hand occurred when a sintered funnel, containing some depleted uranium, broke in the hands of an employee. No evidence of contamination was found in the wound and urinalysis indicated no significant internal exposure.

8. Contamination of an employee and a small area of street surface occurred when the employee dropped a transfer carrier containing a solution of Au-198. A clothing change and repeated hand washing reduced contamination to acceptable levels on the employee; the contaminated surface of the street was removed and replaced.

Pocket meter readings indicated an external exposure of about 20 mrad and urinalysis indicated no significant internal exposure.

9. An operator's failure to follow a written run procedure led to the pressurization of a VPP dissolver vessel with a subsequent release of radioactive material (mostly Sb-125 and Ru-106) to the penthouse area of Bldg. 3019. Transferable contamination levels in the vicinity averaged approximately 3.7×10^4 d/m/100 cm^2.

Nasal smears taken from the two employees present at the time of the release counted up to 1.3×10^4 d/m; skin contamination up to 2 mrad/hr was detected. Standard decontamination techniques quickly reduced skin contamination to non-detectable levels. Pocket meter readings indicated no measurable external exposure and neither urinalysis nor whole body counter examinations indicated a significant internal exposure.

10. Transferable contamination up to 3.8×10^4 d/m/100 cm^2 resulted in Bldg. 3033 when a 10-curie ampoule of tritium was dropped and broken. Only two employees were involved. Neither individual showed evidence of skin contamination when checked after having taken shower baths. Urinalyses indicated no significant internal exposure.

11. ORNL Health Physics investigated (for AEC) the leakage of liquid waste from one of several 55-gallon drums constituting an off-site waste shipment to the ORNL burial ground. The leakage resulted in surface contamination reading up to 10 mrad/hr of a tractor-trailer unit and a small area of a parking lot at AEC Patrol Headquarters. After taking the precautions necessary to prevent further leakage, the shipment was moved to the ORNL burial ground and unloaded. The tractor and trailer were decontaminated at ORNL. The contaminated surface at the parking lot was replaced.

12. Surface contamination (involving Sr-Y-90 and Cs-137) in the northeast section of the second level of Bldg. 3517 was discovered after the protective clothing of an employee who had removed two strontium waste samples from a cubicle at Cell 19 was found contaminated up to 20 mrad/hr. Other personnel who had been in the area before the contamination was detected and isolated had contaminated shoes.

Urinalysis results were positive on one employee but subsequent samples established that the exposure was considerably less than the maximum permissible[2].

13. Contamination of a section of street west of Bldg. 3038 occurred when a carrier that was being unloaded tilted releasing radioactive liquid to the street. Transferable contamination up to 3.7×10^3 d/m ($\beta\gamma$) and 740 d/m (α) was detected over a strip about two inches wide for a distance of about 20 feet. Decontamination of the street was effective.

14. An employee was exposed to the radioactive atmosphere of Cell 6 in Bldg. 3019 when a positive air supply mask was pulled off and broken while performing work in a confined space. The protective clothing was contaminated; however, no detectable skin contamination occurred.

Nasal swabs and urinalysis indicated no significant internal exposure.

3.0 PERSONNEL MONITORING

3.1 External Dose Measurements - The highest whole body exposure recorded during the quarter (see Table 5.1) was 1.7 rem, which represents 57% of the maximum permissible quarterly dose (MPD_Q). The second highest exposure (sustained by two employees) in this category was 50% of the MPD_Q or about 1.5 rem. The highest whole body skin dose recorded during the quarter was 4.6 rem, which is 46% of the MPD_Q[3] for this type of exposure. The second highest whole body skin dose was 4.3 rem, or 43% of the MPD_Q.

3.2 Internal Dose Measurements - At the conclusion of the second quarter, three employees continued to show an estimated bone burden of Pu^{239} in excess of 30 per cent[4] of the maximum permissible level as determined from urinalysis by currently established methods. These employees have submitted urine samples routinely over the past several months and there is continued evidence that the deposition of Pu^{239} in the bone will not exceed approximately 1/3 of the maximum permissible body burden.

4.0 ENVIRONMENTAL MONITORING

4.1 Air-Borne Radioparticulate Measurements - The average concentrations of radioactive materials in air sampled by the three ORNL air monitoring networks are given in Table 5.2. Quarterly average values for the three

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[2] Resamples are requested when analyses on a given specimen yield counting results sufficiently in excess of an arbitrary "action point" to suggest the necessity for continued surveillance.

[3] The MPD_Q established by the FRC for the skin of the whole body is 10 rem.

[4] The action point for curtailing an employee's exposure to internal emitters.

(LAM, PAM, and RAM)[5] networks was 4.6×10^{-12} μc/cc. This concentration is about the same as that reported for April and May, (1962) by twelve stations[6] constituting part of the U.S. Public Health Radiation Surveillance Network located in Tennessee and surrounding states. The quarterly average for the LAM network was 4.5×10^{-12} μc/cc; the combined average for the PAM and RAM networks was 5.0×10^{-12} μc/cc. The above values are approximately two orders of magnitude greater than the average concentrations recorded just prior to the resumption of weapons testing in September of 1961 (Fig. 6.1) and there appears to be only slight variations in concentration when examined on a week by week basis (Table 5.2).

4.2 Fall-Out Measurements - The average number of radioparticulates collected by gummed paper fall-out trays during the second quarter of 1962 decreased to between 23% and 32% of the values observed at the three monitoring networks during the first quarter of 1962. Radioparticulate fall-out for the second quarter was about one order of magnitude less than the fall-out observed in November of 1961 following the resumption of weapons testing (Fig. 6.3). Considerable variation was observed in the average particle count during the quarter within each network; here the values ranged from a minimum of about 1/10 the quarterly average to a maximum of about three times the quarterly average (Table 5.4).

4.3 Water Analysis

Rain Water - The quarterly average concentrations of radioactive materials in rain water for the LAM, RAM, and PAM networks were 1.1×10^{-6} μc/ml, 1.2×10^{-6} μc/ml, and 1.5×10^{-6} μc/ml respectively. These values were slightly less than the values reported for the first quarter of 1962. Average concentrations recorded for each collection station are given in Table 5.3. A comparison between network values for the first and second quarters of 1962 and the three previous years is shown in Fig. 6.2.

The average concentration for the three networks was slightly less than the average reported by twelve stations of the U.S. Public Health Radiation Surveillance Network located in Tennessee and surrounding states[6].

Clinch River Water - Approximately 274 beta curies of radioactivity were discharged via White Oak Creek into the Clinch River during the second quarter, 1962. The isotopic distribution of radionuclides in the White Oak Creek effluent is given separately for the months of April, May, and June in Table 5.5

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[5] LAM - Local Air Monitor (located at or near the ORNL site); PAM - Perimeter Air Monitor (located on the outer boundary of the AEC controlled area); RAM - Remote Air Monitor (located from 12 to 75 miles from ORNL).

[6] One station in Nashville, Tennessee and one station in each of the following states surrounding Tennessee: Illinois, Indiana, Ohio, Kentucky, Virginia, North Carolina, South Carolina, Georgia, Mississippi, Arkansas, and Missouri.

Assuming uniform mixing of White Oak Creek with Clinch River water at the juncture of the two streams (CRM 20.8), the calculated monthly average gross beta concentration in the Clinch River following dilution was as follows:

Month	Concentration
April	0.51×10^{-6} μc/ml
May	0.11×10^{-6} μc/ml
June	0.36×10^{-6} μc/ml

The values shown above represent 9.4, 3.9, and 7.7 per cent (Table 5.6) of the maximum permissible concentration $(MPC)_w$ applicable to individuals living in the neighborhood of an atomic energy installation. The average for the quarter was about 7 per cent of the $(MPC)_w$.

The average concentration of radioactive materials in Clinch River water sampled at the ORGDP water filtration plant (CRM 14.5) was as follows:

Month	Concentration
April	0.39×10^{-6} μc/ml
May	0.05×10^{-6} μc/ml
June	0.22×10^{-6} μc/ml

The above values represent 20.9, 7.6, and 8.7 per cent of the $(MPC)_w$ for the specific mixture of radionuclides present (Table 5.7). The average for the quarter was about 12 per cent of the $(MPC)_w$.

The highest concentrations observed during the quarter occurred during the first two weeks of April when levels reached about 28 per cent of the weighted $(MPC)_w$ value. The high concentrations were due largely to reduced river flow through Norris Dam and subsequent low dilution afforded by the river. The concentration returned to approximately 9 per cent of the $(MPC)_w$ by the end of the month. A comparison of the per cent $(MPC)_w$ at CRM 20.8 and CRM 14.5 are shown for the current 12 month period and for the calendar year 1961 in Figure 6.4.

4.4 Background Measurements of Ionizing Radiation - The average background level for the 53 stations located on the Laboratory site was 0.096 mr/hr. The average level for the five stations located off-site around the perimeter of the controlled area was 0.030 mr/hr. Only normal variations in background were observed (see Table 5.8) and the averages for the quarter are comparable with the yearly averages observed since 1959 (see Fig. 6.5).

5.0 TABLES

PAGE

Table 5.1 Personnel Monitoring Exposure Resume—2nd Q, 1962

Employee	Division	Second Quarter Dose (rem)			Cumulative Dose for 1962 (rem		
		D_s	D_c	% MPD_Q	D_s	D_c	% MPD_A
A	Chem. Tech.	4.3	1.7	57	5.9	2.3	20
B	Health Physics	3.4	1.5	50	3.4	1.5	13
C	Chem. Tech.	2.8	1.5	50	6.5	2.9	24
D	Isotopes	1.9	1.4	47	3.9	3.0	25
E	Isotopes	1.8	1.4	47	3.9	3.1	26
F	Chem. Tech.	4.6	1.3	46	5.8	1.9	19
G	Chem. Tech.	3.4	1.3	43	3.6	1.7	14
H	Isotopes	1.6	1.3	43	3.2	2.8	23
I	Isotopes	1.5	1.3	43	2.0	1.6	13
J	Anal. Chem.	1.5	1.3	43	1.7	1.5	13
K	Chem. Tech.	2.4	1.1	37	3.6	1.7	14
L	E and M	1.7	1.1	37	1.7	1.1	9
M	Isotopes	1.4	1.0	33	2.6	2.0	17

Note: Table 5.1 includes a breakdown of exposures for employees where a dose exceeds approximately 1/3 of the MPE as follows: (1) employees whose quarterly dose exceeded 3.0 rem for the skin of the whole body (D_S) or 1.0 rem for the total body (D_C), and/or (2) employees whose dose for the year to date exceeds a D_S of 10.0 rem or a D_C of 4.0 rem.

Table 5.2 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—2nd Q, 1962

Week No	LAM Network[a]	PAM Network[b]	RAM Network[c]
14	4.2×10^{-12} μc/cc	3.7×10^{-12} μc/cc	4.7×10^{-12} μc/cc
15	3.4	3.2	3.9
16	5.6	5.5	6.3
17	7.2	7.2	8.5
18	4.6	4.4	5.3
19	4.1	4.0	4.7
20	5.4	5.0	5.5
21	5.6	5.2	5.8
22	2.8	2.6	3.1
23	2.7	2.7	3.3
24	4.9	4.0	5.0
25	4.7	5.1	5.0
26	3.4	3.8	4.0
Quarterly Average	4.5×10^{-12} μc/cc	4.3×10^{-12} μc/cc	5.0×10^{-12} μc/cc
Year to date Average	4.2×10^{-12} μc/cc	4.1×10^{-12} μc/cc	4.9×10^{-12} μc/cc

[a]LAM - Local Air Monitor located at or near the X-10 site.

[b]PAM - Perimeter Air Monitor located on the outer boundary of AEC-controlled area.

[c]RAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

Table 5.3 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—2nd Quarter, 1962

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	1.1×10^{-6} µc/ml
	PAM Network	
HP-31	Kerr Hollow Gate	0.8×10^{-6} µc/ml
HP-32	Midway Gate	1.7
HP-33	Gallaher Gate	1.1
HP-34	White Oak Dam	0.9
HP-35	Blair Gate	1.5
HP-36	Turnpike Gate	1.2
HP-37	Hickory Creek Bend	1.1
Network Average		1.2×10^{-6} µc/ml
	RAM Network	
HP-51	Norris Dam	1.4×10^{-6} µc/ml
HP-52	Loudoun Dam	1.8
HP-53	Douglas Dam	1.4
HP-54	Cherokee Dam	1.4
HP-55	Watts Bar Dam	1.7
HP-56	Great Falls Dam	1.8
HP-57	Dale Hollow Dam	1.1
Network Average		1.5×10^{-6} µc/ml

Table 5.4 Radioparticulate Fall-Out Measurements Averaged Weekly from Gummed Paper Data—2nd Quarter, 1962

Week Number	LAM Network	PAM Network	RAM Network
14	31 particles/ft^2	34 particles/ft^2	25 particles/ft^2
15	37	28	27
16	7	4	1
17	7	3	1
18	6	3	3
19	26	11	15
20	11	2	6
21	23	17	22
22	14	13	7
23	8	4	6
24	4	2	4
25	18	18	19
26	8	8	8
Quarterly Average	15 particles/ft^2/wk	11 particles/ft^2/wk	11 particles/ft^2/wk
Year to date Average	30 particles/ft^2/wk	30 particles/ft^2/wk	24 particles/ft^2/wk

Table 5.5 Radionuclides in White Oak Lake Effluent—
2nd Quarter, 1962

Isotope	% of Total Beta Radioactivity April	May	June	
Ru^{106}	95.41	91.28	95.40	
Zr^{95}	0.07	0.03	0.03	
Tre-Ce*	1.74	4.21	0.88	
Cs^{137}	0.26	0.12	1.10	
I^{131}	0.02	0.03	0.01	
Ce^{144}	0.16	0.50	0.10	
Nb^{195}	0.11	0.18	0.05	
Ba^{140}	0.02	0.03	0.01	
Co^{60}	1.11	0.47	1.00	
Sr^{89}	0.11	0.32	0.14	
Sr^{90}	1.00	2.83	1.27	
Total Beta Curies Discharged	146	27	101	274

*Total Rare Earths Minus Cerium

Table 5.6 Average Concentration of Radioactive Materials in the Clinch River at Mile 20.8—2nd Quarter, 1962

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)					Gross Beta	$(MPC)_w$[b]	%
	Sr^{90}	Ce^{144}	Cs^{137}	$Ru^{103-106}$	Co^{60}	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
April	0.56	0.09	0.15	54	0.63	0.51	5.44	9.4
May	0.18	0.03	0.01	6	0.03	0.11	2.79	3.9
June	0.45	0.04	0.39	34	0.35	0.36	4.66	7.7

[a]Concentrations at Mile 20.8 are calculated using the dilution factor afforded by the river and the observed concentrations in White Oak Lake effluent.

[b]Weighted average $(MPC)_w$ for populations in the neighborhood of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.7 Average Concentration[a] of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—2nd Quarter, 1962

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)		Gross Beta	$(MPC)_w$[b]	%
	Sr^{89-90}	$Ru^{103-106}$	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
April	1.71	40	0.39	1.85	20.9
May	0.81	5.0	0.05	0.68	7.6
June	0.72	22	0.22	2.52	8.7

[a]Observed values based on analyses of weekly composited samples.

[b]Weighted average $(MPC)_w$ for populations in the vicinity of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.8 Background Measurements of Ionizing Radiation - 2nd Qtr. 1962

Area	Monthly Average for All Stations (mr/hr)			Quarterly Average for All Stations (mr/hr)	Year to Date Average All Stations (mr/hr)
	April	May	June		
Laboratory Site (53 stations)	0.093	0.090	0.106	0.096	0.090
Off-Site (5 stations)	0.034	0.026	0.030	0.030	0.028

Note: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mr/hr.

6.0 FIGURES

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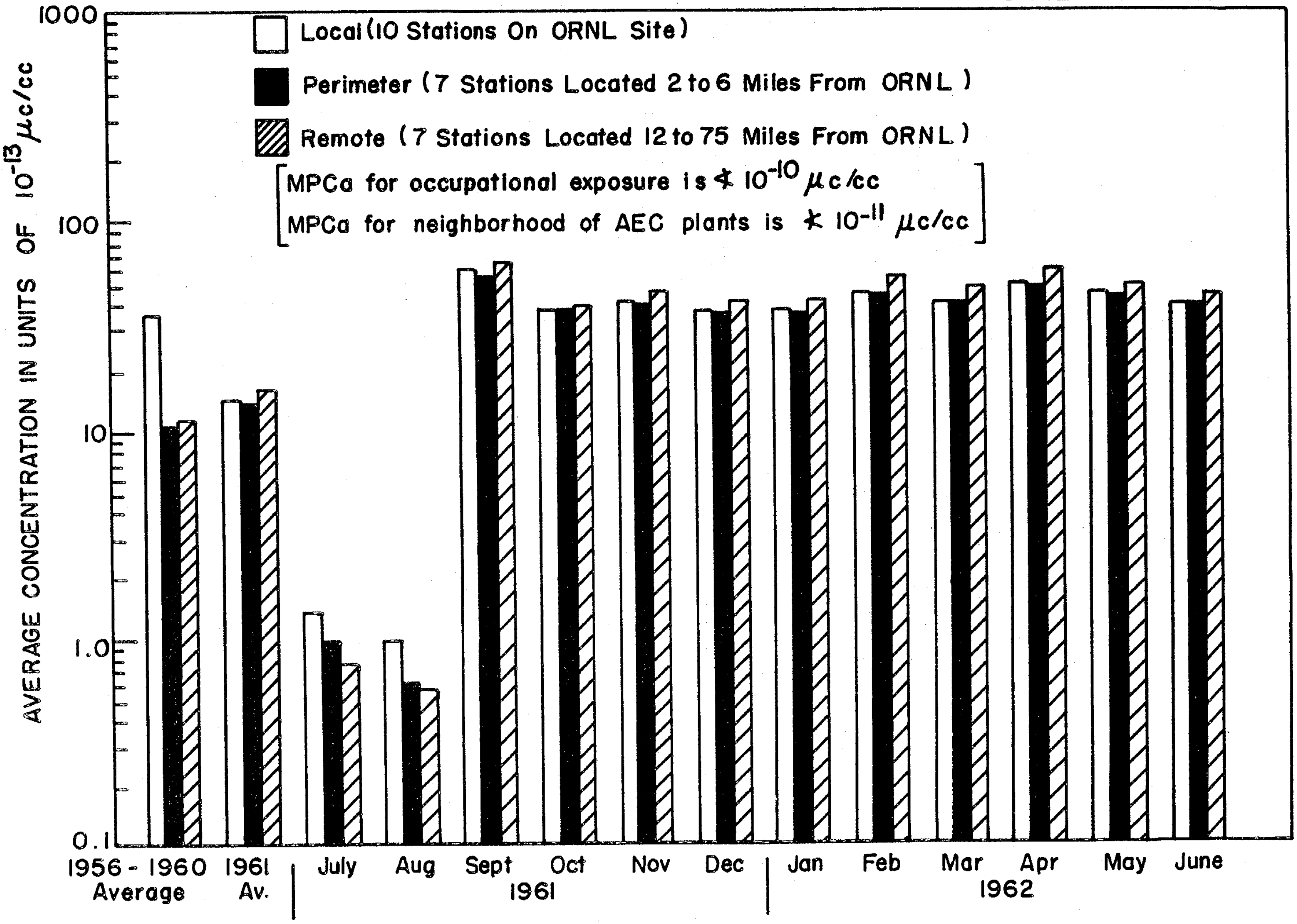

Fig 6.1 Concentration Of Radioactive Materials in Air (Filter Paper Data)

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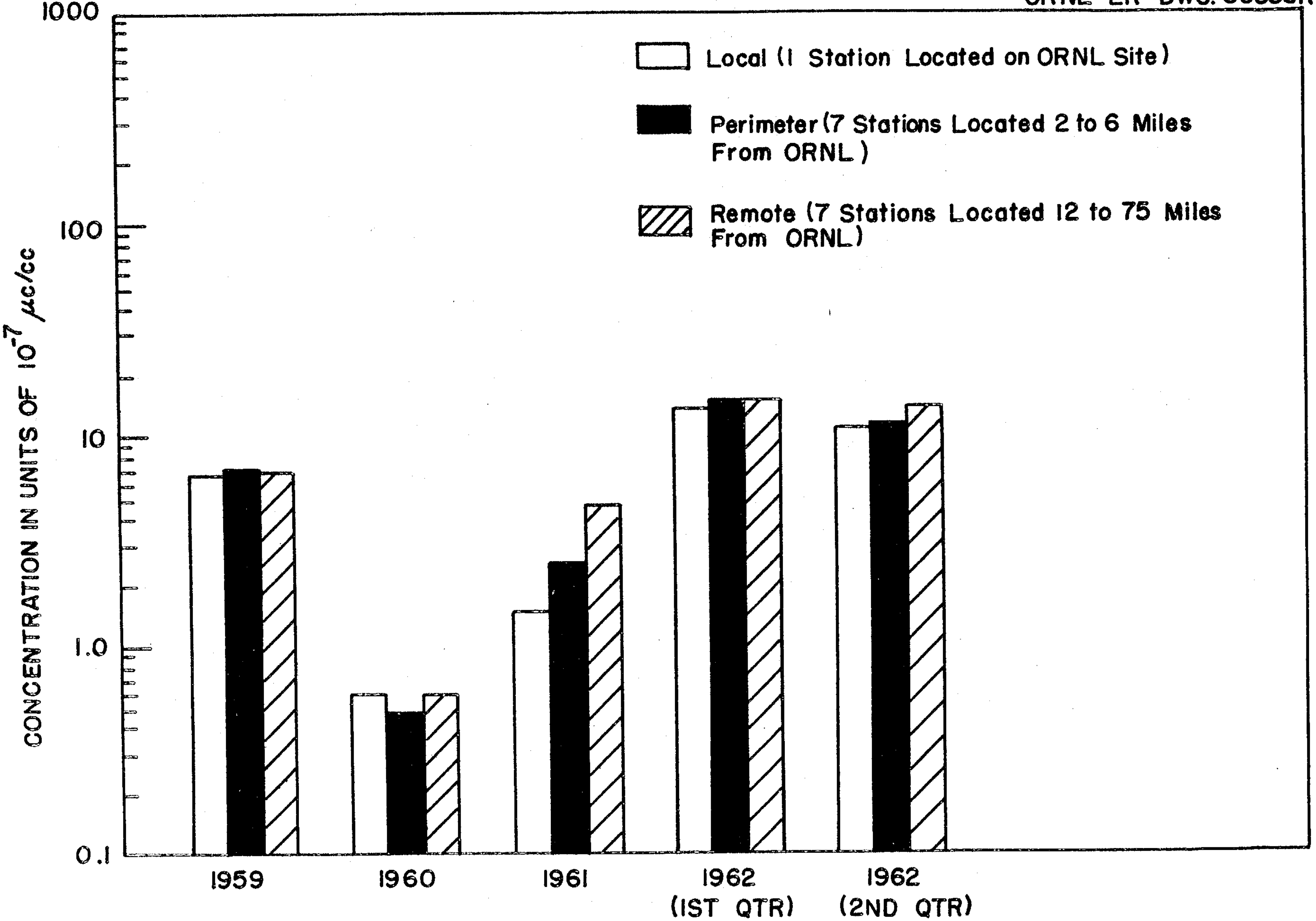

Fig 6.2 Concentration Of Radioactive Materials In Rain Water

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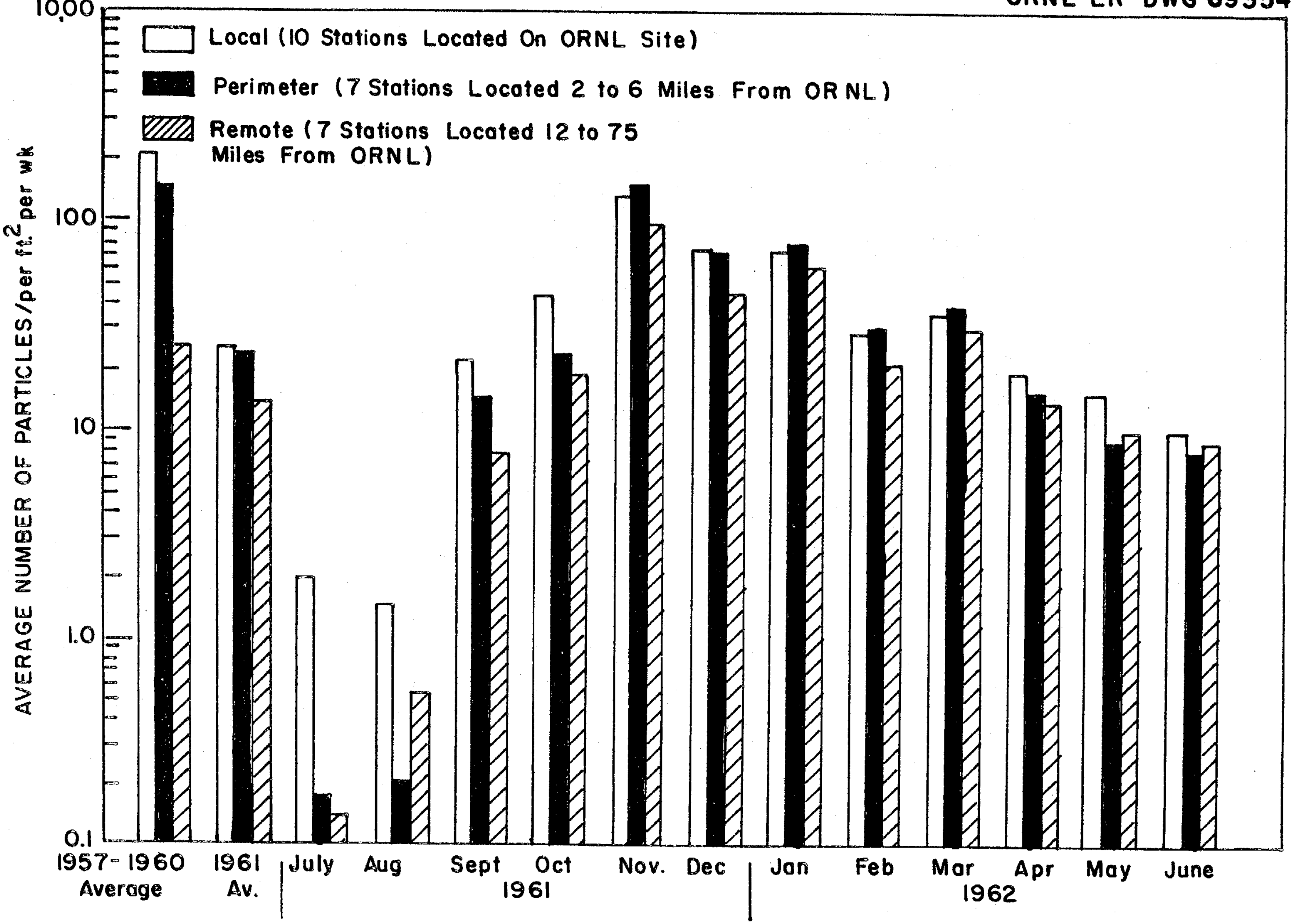

Fig. 6.3 Radioparticulate Fall-Out Measurements (Measured By Autoradiographic Techniques Using Gummed Paper Collectors)

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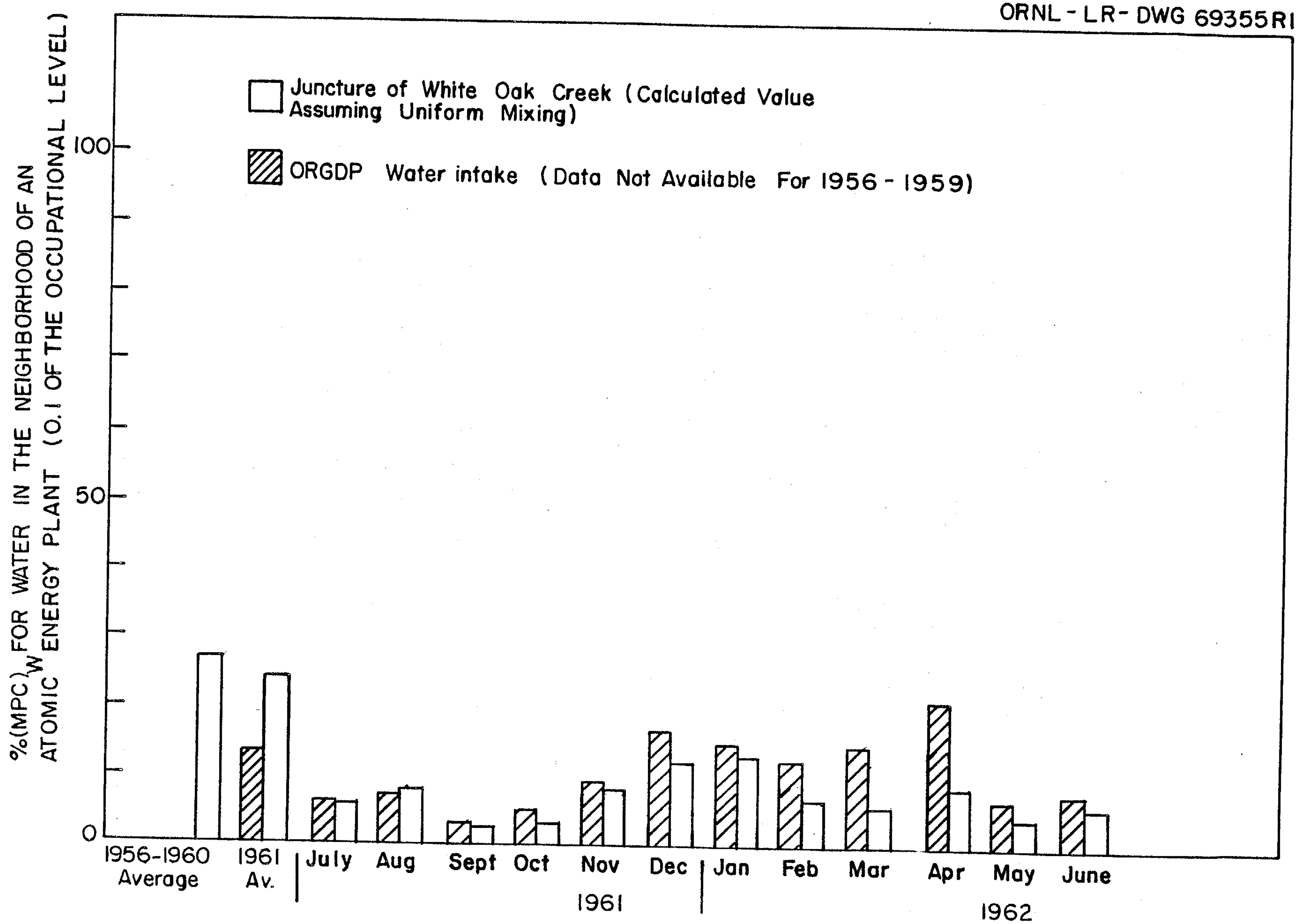

Fig. 6.4 Radioactive Content Of Clinch River Water

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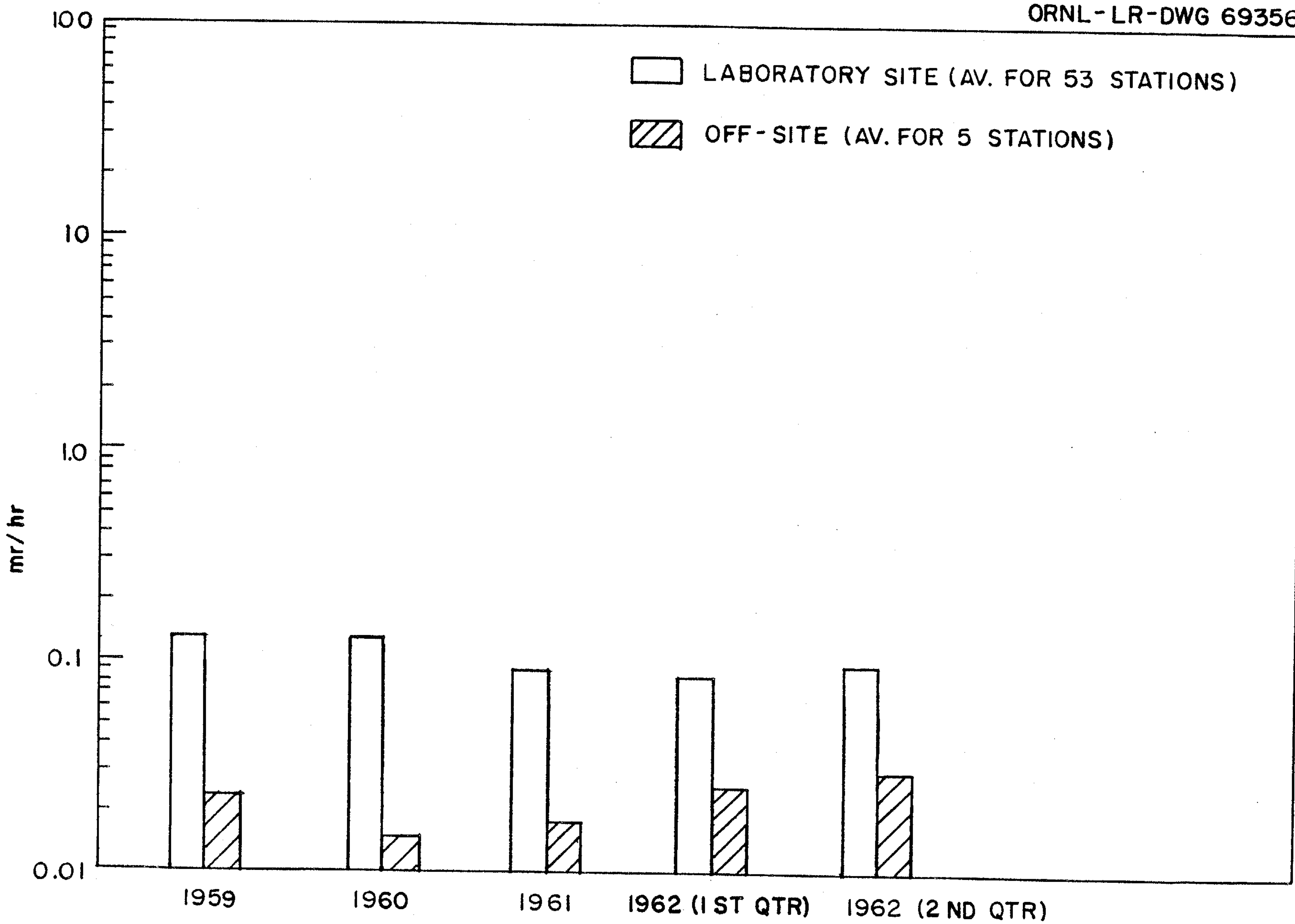

Fig. 6.5 Background Measurements Of Ionizing Radiation

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76. A. R. Olsen
77. J. J. Pinajian
78. M. E. Ramsey
79. M. L. Randolph
80. L. P. Riordan
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TO: K. Z. Morgan - W. S. Snyder

FROM: D. M. Davis

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Technical Information Officer Date
ORNL Site

NOTICE

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - APRIL, MAY, AND JUNE OF 1963

D. M. Davis, Section Chief

J. C. Hart, Editor

Data Contributed By:

H. H. Abee
E. D. Gupton
A. D. Warden

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1.0 MONITORING SUMMARY

1.1 Unusual Occurrences

The Laboratory experienced 13 unusual occurrences during the second quarter of 1963, and all 13 events were classified as minor. The quarterly average for 1962 was 15.

1.2 Personnel Exposures

No employee exceeded a recommended maximum quarterly dose. Only ten employees received an exposure in excess of 1/3 of the recommended maximum values.

1.3 Atmospheric Monitoring

Air-borne radioparticulate matter collected by the LAM network (Laboratory area) averaged 7.8×10^{-12} μc/cc during the quarter; the average value determined from the data generated by the PAM network (AEC controlled area) was 7.0×10^{-12} μc/cc; the value for the RAM network (remote stations) was 6.9×10^{-12} μc/cc. The above values are consistent with other monitoring data which indicate that ORNL operations did not contribute significantly to air contamination levels recorded in the East Tennessee area during the second quarter of 1963.

1.4 Water Monitoring

Clinch River water taken from the ORGDP water intake during the quarter averaged 6 per cent of the recommended maximum $(MPC)_w$ for persons residing in the neighborhood of an atomic energy installation. The average recorded during 1962 was 11.2 per cent of the $(MPC)_w$.

1.5 Background Measurements of Ionizing Radiation

The background radiation at ORNL averaged 0.11 mR/hr during the second quarter of 1963. The background level measured at individual stations ranged from a minimum of 0.020 mR/hr to a maximum of 1.6 mR/hr. The off-site average was 0.032 mR/hr. The quarterly average recorded during 1962 at ORNL was 0.11 mR/hr; the off-site average during 1962 was 0.020 mR/hr.

2.0 UNUSUAL OCCURRENCES[1]

2.1 Unusual Occurrences - 2nd Quarter, 1963

The Laboratory experienced 13 unusual occurrences during the second quarter and all 13 events were classified as minor. Three events (Table 5.1, Items 1, 5 and 10) were attributed to faulty or inadequate equipment; eight events (Table 5.1, Items 2, 3, 6, 7, 8, 9, 11 and 12) were attributed to the failure to use adequate care in some part of the operation; two events (Table 5.1, Items 4 and 13) were due to the failure of employees to follow operating procedures. Thus, the majority of the unusual occurrences were the result of carelessness in performing the work routine.

All 13 unusual occurrences involved area and/or equipment contamination. Decontamination was handled internally by the regular work staff with no appreciable departmental program loss.

Eleven of the occurrences involved minor personnel contamination. In only two instances was it necessary to refer personnel to the Health Division for followup on the decontamination effort.[2]

Unusual occurrences took place in seven operating facilities (Table 5.1). Four of the incidents occurred in one facility with two incidents occurring in each of three other facilities. Three facilities experienced one unusual occurrence each. Nine of the unusual occurrences were within facilities concerned primarily with chemical type operations. The remaining four incidents occurred in facilities where mechanical or service-type operations were being performed.

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[1] See the Applied Health Physics Quarterly Report for January, February and March of 1963 for an updated definition of the term "Unusual Occurrence". This report also describes a method for classifying radiation accidents, or near accidents, according to a severity index system.

[2] Personnel are referred to the Health Division when it becomes apparent that repeated scrubbings will result in an irritation of the skin.

3.0 PERSONNEL MONITORING

3.1 External Dosimetry

No employee exceeded a recommended maximum quarterly dose. The highest exposure, in terms of per cent of recommended maximum levels, was a total body dose of 1.9 rem which represents 63 per cent of the recommended maximum quarterly dose of 3 rem. Ten individuals received a total body dose that equalled or exceeded 1/3 of the recommended maximum quarterly dose. The highest cumulative dose accrued this year through the second quarter was 2.7 rem, which represents 55 per cent of the recommended maximum yearly average dose of 5 rem. The highest total body skin dose received during the quarter was 1.9 rem, which is 19 per cent of the recommended maximum quarterly limit. A breakdown of exposures is shown in Table 5.2.

3.2 Internal Dosimetry

Bio-Assays - Three employees continued to have estimated bone burdens of Pu-239 which approximate 1/3 of the recommended maximum body burden. No new cases involving a significant body burden developed during the second quarter.[3]

Whole Body Counter[4] - A total of 228 human counts on 211 persons was carried out by the staff of the whole body counting facility during the second quarter. Among the number counted, 42 individuals indicated measurable amounts of radioactivity above the average unexposed human background of about 15 nanocuries Cs-137; 12 individuals were shown to have accumulated two or more isotopes not normally found in the average person.

Radioactivity Found in Routine Whole Body Monitoring Program - April, May, June, 1963

Isotope	No. of Persons	Highest Quantity Measured (nc)	Per Cent of MPBB
Co-60	10	220	2.2
Zn-65	6	16	0.03
Se-75	3	250	0.25
Sr-90	1	$\leq$ 35	0.18
Ru-106	4	47	0.47
Sb-125	2	trace	----
I-131	2	trace	----
Cs-137	26	190	0.63

[3] Action is taken to curtail and employee's exposure to internal emitters when measurements approach 30 per cent of a recommended maximum body burden.

[4] Data supplied by the Health Physics Technology Section.

4.0 ENVIRONMENTAL MONITORING

4.1 Atmospheric Monitoring

Twelve additional air monitoring stations are in the process of being added to the LAM[5] network which will bring the network total to 22 stations. Newly acquired instrumentation is currently undergoing calibration and being integrated into the environmental monitoring telemetering system which feeds information to Applied Health Physics Headquarters. New stations were required following the erection of new operating facilities which resulted in a sizable expansion of the Laboratory work area. Continuous fall-out monitors have been designed and are being fabricated as an addition to the LAM system. These units will be added to each of the LAM stations later in the year.

Continuous sampling for radioiodine has been effected at each station in the PAM[6] network as the result of an increased emphasis in this field of monitoring. The sampling technique utilizes an activated charcoal cartridge that is located in the air sampling line between the particulate filter and the air pump. Cartridges are removed each week and examined for radioiodine by gamma spectrometry.

No significant changes or alterations have been made in the RAM[7] network during the quarter.

The average weekly concentrations of radioactive materials in air sampled by the three ORNL air monitoring networks are shown in Table 5.3. The quarterly average for the LAM network was 7.8×10^{-12} μc/cc with weekly values at individual monitoring stations ranging from a minimum of 1.5×10^{-12} μc/cc to a maximum of 13×10^{-12} μc/cc. Averages for the PAM and RAM networks were 7.0×10^{-12} μc/cc and 6.9×10^{-12} μc/cc respectively with weekly values ranging from a minimum of 3.2×10^{-12} μc/cc to a maximum of 13×10^{-12} μc/cc. The radioactive concentration in air which has been relatively high since mid 1962 apparently peaked during the month of April, and exhibited a slight downward trend during the remainder of the quarter. The relative uniformity in values measured between all networks (Fig. 6.1) reflects the persistent effects of world-wide weapons testing and indicates that ORNL operations did not contribute significantly to air-borne radioactivity.

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[5] LAM - Local Air Monitor (located at or near the ORNL site).

[6] PAM - Perimeter Air Monitor (located on the outer boundary of the AEC controlled area).

[7] RAM - Remote Air Monitor (located from 12 to 75 miles from ORNL).

4.2 Fall-Out Measurements

Fall-out measurements by the gummed paper technique[8] indicate that fall-out of radioactive particles per square foot has decreased by an order of magnitude from the previous quarter. The measured values are given, by weeks, for all networks in Table 5.4. There has been a steady downward trend in the number of radioparticulates occurring as fall-out since the first part of the year (Fig. 6.2).

4.3 Water Analysis

Rain Water - The quarterly average concentration of radioactivity in rain water collected over the LAM and PAM networks was 1.3×10^{-6} μc/ml; the RAM network average was 2.0×10^{-6} μc/ml. The above values are approximately the same as those recorded during the first quarter of 1963.

Clinch River Water - Approximately 74 curies of radioactive materials were discharged via White Oak Creek into the Clinch River during the second quarter of 1963 as compared to 289 curies discharged during the first quarter. The isotopic distribution of the White Oak Lake effluent is given for the months of April, May, and June in Table 5.6. About 90 per cent of the radioactivity contained in White Oak Lake effluent was Ru^{106}, the major portion of which enters White Oak Lake from the seepage pit disposal system.[9] However, Ru^{106} contributed only about 28 per cent to the applicable maximum permissible concentration for drinking water, $(MPC)_w$, which is a calculated value derived for the mixture of radionuclides known to be carried by White Oak Lake effluent as it passes into Clinch River water. Assuming a uniform mixing of White Oak Lake effluent with Clinch River waters at the juncture of the two streams (CRM 20.8), the calculated monthly average gross beta concentration in the Clinch River resulting from ORNL liquid waste discharges was as follows:

Month	Concentration[10]	% $(MPC)_w$[11]
April	0.26×10^{-6} μc/ml	7.5
May	0.27×10^{-6} μc/ml	7.2
June	0.08×10^{-6} μc/ml	3.0
	Average	5.8

[8] The gummed paper collector presents a collection surface of 1 square foot. Radioparticulates per square foot are determined by autoradiography.

[9] Monthly reports, "Laboratory Facilities - Waste Disposal", L. C. Lasher.

[10] Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter the river upstream from CRM 20.8.

[11] Weighted average $(MPC)_w$ for persons residing in the neighborhood of a controlled area calculated for the isotopic mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

The average concentration value for the first quarter of 1963 was about 5% of the $(MPC)_w$.

The measured average concentrations of radioactive materials in Clinch River water sampled at the ORGDP water filtration plant intake (CRM 14.5) were as follows:

Month	Concentration		% $(MPC)_w$
April	0.30×10^{-6} μc/ml		6.4
May	0.18×10^{-6} μc/ml		6.9
June	0.07×10^{-6} μc/ml		4.0
		Average	5.8

A comparison of the per cent $(MPC)_w$, by months, for the first six months of 1963 with values determined for the years 1956 through 1962 is presented in Fig. 6.4.[12]

4.4 Background Measurements of Ionizing Radiation

The average background level recorded during the second quarter at the 53 stations located on or near the Laboratory site was 0.11 mR/hr. The background level measured at individual stations ranged from a minimum of 0.020 mR/hr to a maximum of 1.6 mR/hr. The average level recorded at five stations located off-site around the perimeter of the AEC controlled area was 0.032 mR/hr. The average levels for the quarter, both on-site and off-site, were essentially the same as the average values recorded during 1962. The second quarter background levels recorded at the ORNL site were about ten times those recorded in 1943 (Table 5.9) prior to the start-up of the graphite reactor; the background averages on the perimeter of the AEC controlled area were about two and one-half times the 1943 level. The average background for the first and second quarters of 1963 and for the years 1959 through 1962 is presented in Fig. 6.5.

The Tower Shielding Facility (TSF) was operated in such a manner that during the second quarter the average dose rate at the point (Melton Hill Dam site) nearest the TSF where members of the general public may have unrestricted access approximated natural background levels.

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[12]The water level in Melton Hill Lake reached the full pool stage for the first time on May 30, 1963. Following start-up for power production (probably the first half of 1964), discharges from Melton Hill Dam will be determined by power requirements and plans are currently underway to investigate the effects of the Melton Hill operation on dilution of waste in Clinch River.

4.5 Milk Samples

The environmental monitoring program for the evaluation of radioiodine contained in raw milk was expanded during the quarter in that the number of sampling stations was increased from six to ten. Six of the ten stations, which are located outside the AEC controlled area within a twelve mile radius of ORNL, are sampled at weekly intervals. The four remaining stations, located outside the 12 mile radius up to distances of 50 miles, are sampled once each six weeks.

Radioiodine concentration values derived for 80 per cent of the raw milk samples analyzed during the quarter were below the minimum detectable limit of 10 pc/l. The maximum value measured for an individual sample was 87 pc/l. Assuming 5 pc/l (1/2 the minimum detectable limit) to be the value for each sample below the minimum detectable limit, the average radioiodine concentration for all samples analyzed during the quarter was 10 pc/l which is about 20 per cent of the average concentration recorded during the first quarter of 1963, and about 10 per cent of the 1962 average.

5.0 TABLES

Table 5.1 Radiation Occurrences Tabulated for 2nd Quarter, 1963

No.	Date	Facility(s) Involved	Division(s) Involved	Subject of Occurrence
1.	4-4-63	Bldg. 3550 (Rm-32)	Anal. Chem.	Radioactive Contamination Resulting from Rupture of Quartz Ampoule Containing Al Co-60 Alloy Foil.
2.	4-9-63	Bldg. 3019 (Rm-210)	Anal. Chem.	Am-242 Contamination Resulting from Removal of Sample from Container.
3.	4-18-63	Bldg. 3019 (Penthouse)	Chem. Tech.	Release of Radioactive Contamition During Inspection of Vapor Outlet Line in VPP Operation.
4.	4-22-63	Bldg. 2523 (Laundry)	Operations Health Phys.	Personnel and Facility Contamination Resulting from the Handling of Contamination Type Garments.
5.	4-23-63	Bldg. 3019 (Penthouse)	Chem. Tech.	Release of Air-Borne Radioactive Materials as the Result of a Faulty Vent Line.
6.	4-23-63	Bldg. 3517	Isotopes	Facility Contamination During Replacement of Cover to Cell 10.
7.	4-26-63	Bldg. 3019	Chem. Tech.	Radioactive Contamination Resulting from Handling of Ruptured Container.
8.	4-30-63	Bldg. 3517	Isotopes	Personnel and Facility Contamination Involving Removal of Carrier from Cell 15.
9.	5-3-63	Bldg. 3025 (Hot Cells)	Operations	Spread of Radioactive Contamination During Filter Removal Work in Cell 6.
10.	5-13-63	Bldg. 3019 (Penthouse)	Chem. Tech.	Release of Air-Borne Radioactive Materials During VPP "Rod-Out" Operation.
11.	5-21-63	Bldg. 4508 (Rm-121)	Met & Cer	Personnel and Surface Contamination Resulting from Minor Thorium Fire.
12.	6-3-63	Bldg. 3025	Operations	Personnel and Facility Contamination Resulting from the Removal of Equipment from Cell 6.
13.	6-21-63	Bldg. 3019 (HRLAF)	Anal. Chem.	Spread of Cm-242 Resulting from Failure to Observe an Operational Procedure.

Note: All events tabulated above were classified as minor occurrences.

Table 5.2 Personnel Meters Exposure Resume—2nd Quarter, 1963

Employee	Laboratory Division	Second Quarter Dose		Cumulative Dose for 1963	
		Skin of Total Body (rem)	Total Body (rem)	Skin of The Body (rem)	Total Body (rem)
A	Thermonuclear	1.9	1.9	2.7	2.7
B	I and C	1.3	1.2	2.4	2.2
C	Isotopes	1.6	1.2	2.9	2.4
D	Isotopes	1.5	1.2	3.0	2.4
E	Thermonuclear	1.1	1.1	1.9	1.9
F	Isotopes	1.7	1.1	3.5	2.0
G	Isotopes	1.4	1.1	2.5	1.9
H	Isotopes	1.3	1.1	2.3	1.9
I	Isotopes	1.2	1.0	2.8	2.4
J	Thermonuclear	1.1	1.0	2.2	1.9

Note: Table 5.2 includes a breakdown of exposures for employees whose recorded dose equals or exceeds approximately 1/3 (underlined value) of the recommended maximum quarterly dose.

Table 5.3 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—2nd Quarter, 1963

Week No.	LAM Network[a]	PAM Network[b]	RAM Network[c]
14	8.6×10^{-12} μc/cc	7.9×10^{-12} μc/cc	7.9×10^{-12} μc/cc
15	6.7	6.7	6.5
16	9.1	10.	10.
17	8.4	8.7	8.3
18	9.8	9.5	8.8
19	5.7	5.5	5.2
20	7.2	6.9	6.4
21	6.8	5.8	5.7
22	7.8	7.3	6.7
23	8.1	6.4	7.3
24	8.3	6.9	6.9
25	6.8	4.6	5.0
26	7.7	5.1	5.0
Average for 2nd Quarter	7.8×10^{-12} μc/cc	7.0×10^{-12} μc/cc	6.9×10^{-12} μc/cc
Average for Year to Date	6.5×10^{-12} μc/cc	6.0×10^{-12} μc/cc	6.3×10^{-12} μc/cc
Average for Last Year 1962	3.7×10^{-12} μc/cc	3.6×10^{-12} μc/cc	4.3×10^{-12} μc/cc

[a] LAM - Local Air Monitor located at or near the ORNL site.

[b] PAM - Perimeter Air Monitor located on the outer boundary of the AEC-controlled area.

[c] RAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

Table 5.4 Radioparticulate Fall-Out Measurements Averaged Weekly From Gummed Paper Data—2nd Quarter, 1963

Week No.	LAM Network	PAM Network	RAM Network
14	10 particles/ft^2/wk	8 particles/ft^2/wk	4 particles/ft^2/wk
15	8	3	3
16	3	2	3
17	6	3	1
18	7	4	4
19	3	2	2
20	2	4	1
21	7	4	3
22	2	0.6	0.3
23	7	3	0.4
24	2	1	1
25	0.8	0	0
26	0.9	0.7	0.3
Weekly Average for 2nd Qtr.	4	3	2

Table 5.5 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—2nd Quarter, 1963

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	1.3×10^{-6} μc/ml
	PAM Network	
HP-31	Kerr Hollow Gate	1.4×10^{-6} μc/ml
HP-32	Midway Gate	1.3
HP-33	Gallaher Gate	1.1
HP-34	White Oak Dam	1.4
HP-35	Blair Gate	1.4
HP-36	Turnpike Gate	1.5
HP-37	Hickory Creek Bend	0.9
Network Average		1.3×10^{-6} μc/ml
	RAM Network	
HP-51	Norris Dam	2.1×10^{-6} μc/ml
HP-52	Loudoun Dam	1.0
HP-53	Douglas Dam	2.8
HP-54	Cherokee Dam	1.7
HP-55	Watts Bar Dam	1.2
HP-56	Great Falls Dam	3.8
HP-57	Dale Hollow	1.4
Network Average		2.0×10^{-6} μc/ml

Table 5.6 Radioisotopic Distribution in White Oak Lake Effluent—2nd Quarter, 1963

Isotope	% of Total Beta Radioactivity		
	April	May	June
Ru^{106}	91	92	88
Zr^{95}	0.04	0.07	0.20
Nb^{95}	0.13	0.41	0.48
TRE (less Ce^{144})*	1.6	1.4	1.9
Cs^{137}	0.49	0.28	0.60
I^{131}	0.22	0.10	0.12
Ce^{144}	0.13	0.21	0.04
Ba^{140}	0.04	0.01	0.12
Co^{60}	3.7	3.8	5.0
Sr^{89}	0.22	0.21	0.32
Sr^{90}	2.2	2.0	2.8

* TRE-Total rare earths

Table 5.7 Average Concentration of Major Radioactive Constituents in the Clinch River at Mile 20.8 Resulting from ORNL Waste Releases via White Oak Lake[a]—2nd Quarter, 1963

Month	Radionuclides of Primary Concern (10^{-8} µc/ml)					Gross Beta	$(MPC)_w$[b]	%
	Sr^{90}	Ce^{144}	Cs^{137}	$Ru^{103-106}$	Co^{60}	(10^{-6} µc/ml)	(10^{-6} µc/ml)	$(MPC)_w$[b]
April	0.11	0.006	0.022	4.16	0.17	0.26	3.5	7.5
May	0.24	0.025	0.033	11.00	0.46	0.27	3.7	7.2
June	0.16	0.002	0.035	5.10	0.29	0.08	2.8	3.0

[a]Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter the river upstream from CRM 20.8.

[b]Weighted average $(MPC)_w$ for populations residing in the neighborhood of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.8 Average Concentration[a] of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake (CRM 14.5)—2nd Quarter, 1963

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)		Gross Beta	$(MPC)_w$[b]	%
	Sr^{89-90}	$Ru^{103-106}$	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
April	0.42	24	0.30	4.7	6.4
May	0.59	14	0.18	2.6	6.9
June	0.99	7	0.07	1.6	4.0

[a]Observed values based on analyses of weekly composited samples.

[b]Weighted average $(MPC)_w$ for populations in the vicinity of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.9 Background Measurements of Ionizing Radiation—2nd Quarter, 1963

Area	Monthly Average for All Stations (mR/hr)			Quarterly Average for All Stations (mR/hr)	Year to Date Average All Stations (mR/hr)
	April	May	June		
Laboratory Site (53 stations)	0.11	0.09	0.13	0.11	0.11
Off-Site (Oak Ridge Controlled Area) (5 stations)	0.027	0.039	0.032	0.032	0.029

Note: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

6.0 FIGURES

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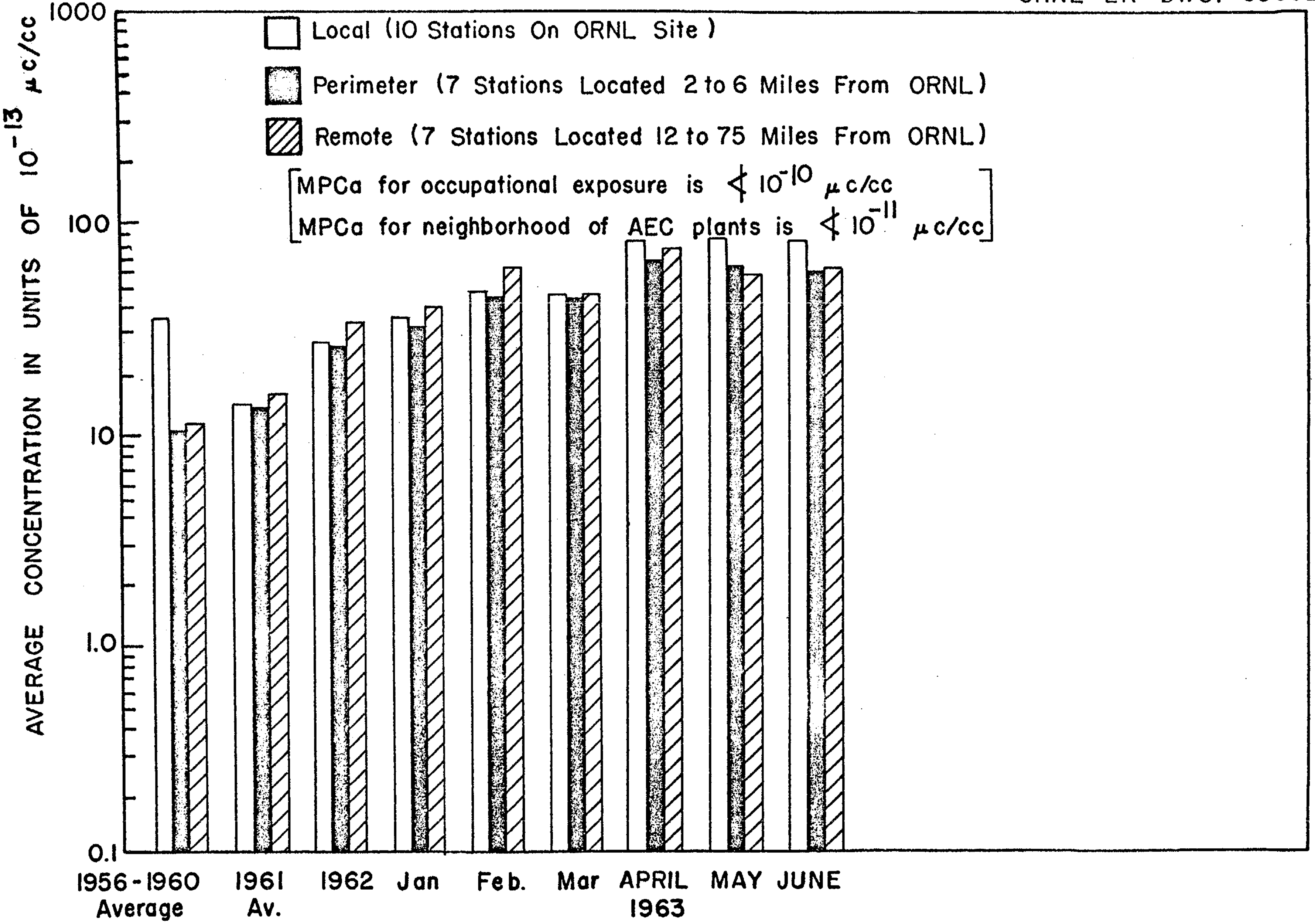

Fig. 6.1 Concentration Of Radioactive Materials in Air
(Filter Pape[r D]ata)

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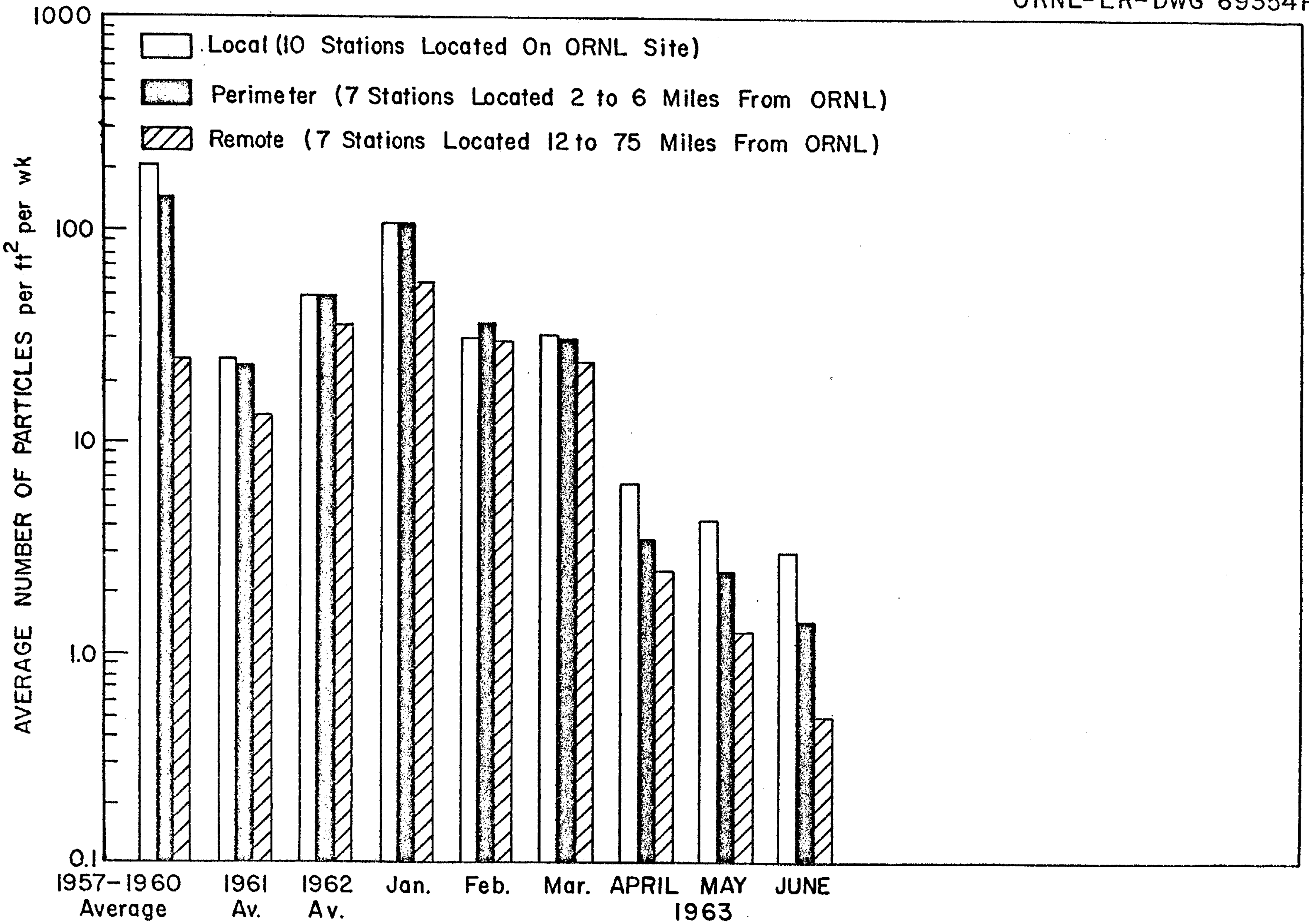

Fig. 6.2 Radioparticulate Fall-Out Measurements (Measured By Autoradiographic Techniques Using Gummed Paper Collectors)

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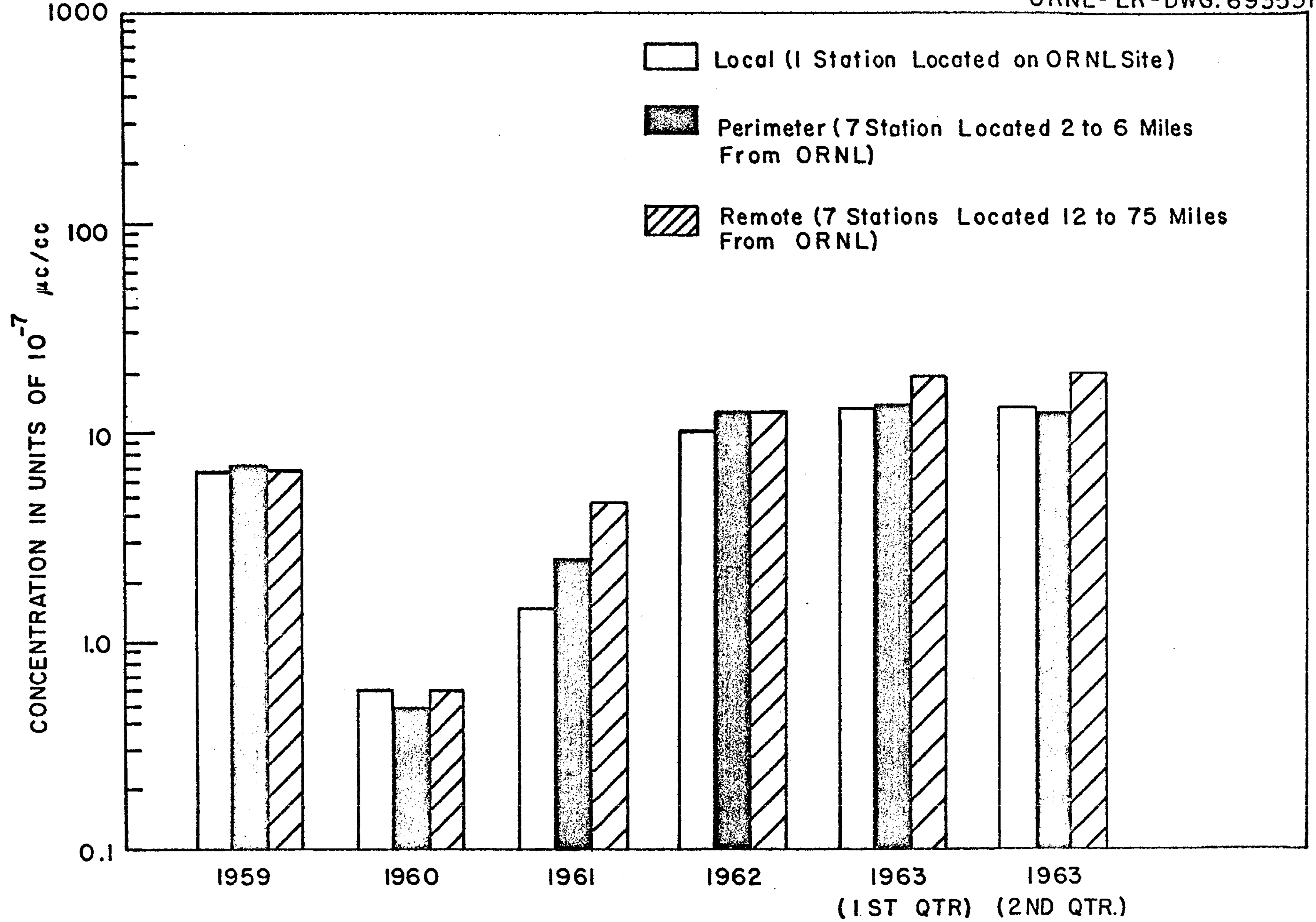

Fig 6.3 Concentration Of Radioactive Materials In Rain Water

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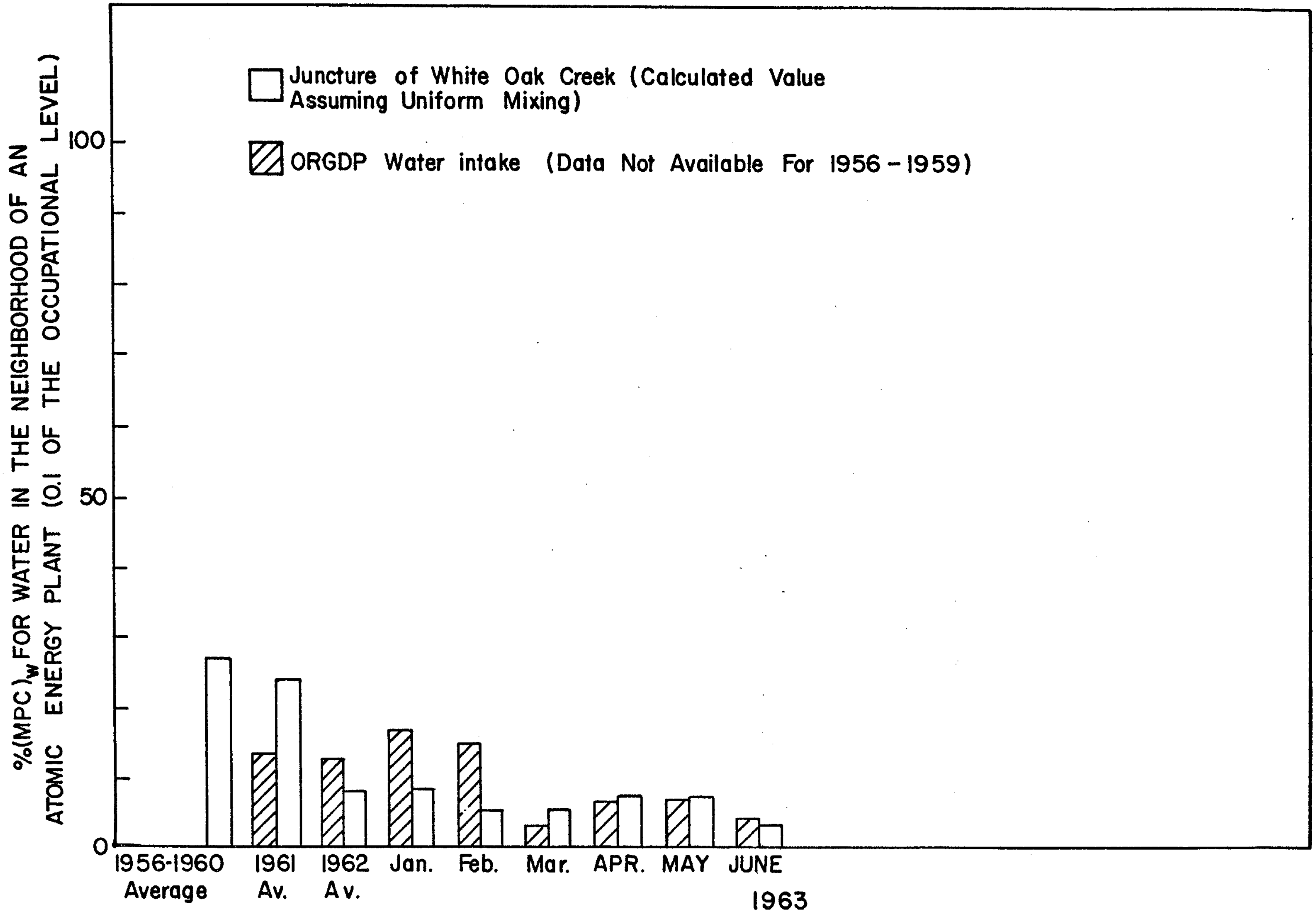

Fig.6.4 Radioactive Content Of Clinch River Water

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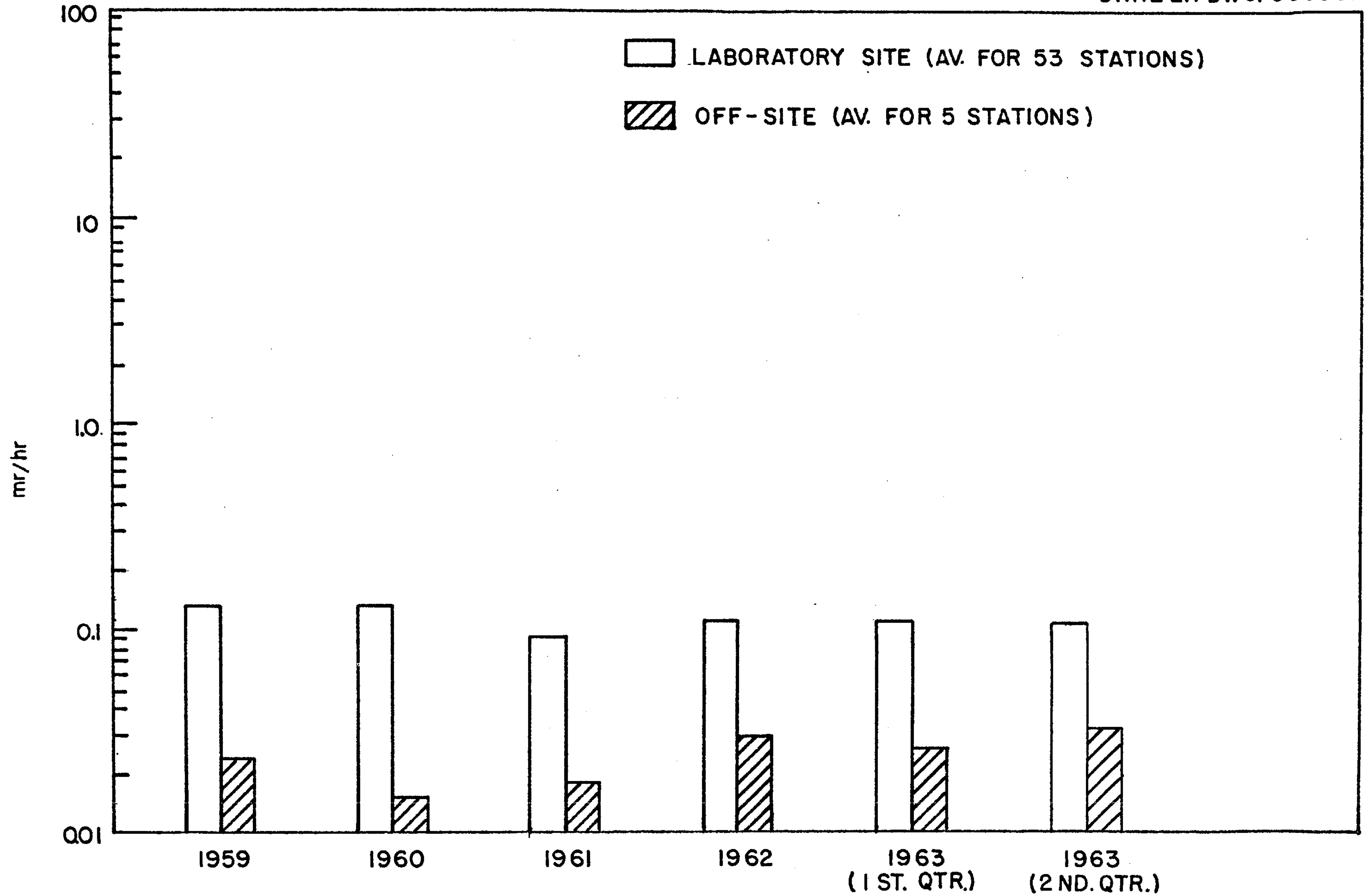

Fig 6.5 Background Measurements Of Ionizing Radiation

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SUBJECT: APPLIED HEALTH PHYSICS QUARTERLY REPORT - OCTOBER, NOVEMBER AND DECEMBER OF 1963

TO: K. Z. Morgan - W. S. Snyder

FROM: D. M. Davis

NOTICE

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - OCTOBER, NOVEMBER AND DECEMBER OF 1963

D. M. Davis, Section Chief

Data Contributed By:

H. H. Abee
R. L. Clark
E. D. Gupton
A. D. Warden

J. C. Hart, Editor

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1.0 MONITORING SUMMARY

1.1 Unusual Occurrences

Seven unusual occurrences were recorded during the fourth quarter. The numbers for the first, second and third quarter were 13, 13, and 10 respectively. Six of the fourth quarter occurrences were classified as minor occurrences; one was classified as a radiation event because an employee received a tritium exposure which exceeded recommended maximum levels.

1.2 Personnel Exposures

One employee received an exposure to tritium which resulted in an estimated body deposition of approximately 86 mc—equivalent to about three years exposure at $(MPC)_a$ levels. No employee exceeded a recommended maximum quarterly dose from external radiation.

1.3 Environmental Monitoring

The concentration of radioactivity in the air over the East Tennessee area continued a downward trend during the fourth quarter, 1963. Fourth quarter concentration averages at all air monitoring networks dropped by a factor of about three from the third quarter levels.

The average concentration of radioactive materials in the Clinch River waters attributable to Laboratory operations was about two per cent of the calculated $(MPC)_w$, approximately one-half of the third quarter level.

A decrease in fall-out from weapons tests during the fall quarter presumably is in large measure responsible for the decrease in environmental contamination.

2.0 RADIATION SURVEY SECTION

2.1 Summary of Unusual Occurrences

Seven unusual occurrences at the Laboratory were recorded during the fourth quarter. The numbers for the first, second, and third quarter were 13, 13, and 10 respectively. One of the seven unusual occurrences was classified as a radiation event; the remaining six were classified as minor occurrences.[1] Two occurrences were attributed to faulty or inadequate equipment (Table 2.1, Items 2 and 5); the other five were attributed to failure to use adequate care in some of the operations (Table 2.1, Items 1, 3, 4, 6, and 7).

Contamination of an area and/or equipment occurred in six of the unusual occurrences. The decontamination efforts required were handled internally by the regular work staff with no appreciable program losses. Personnel contamination was involved in five of the occurrences; in four cases the contamination was minor but one case (see Section 2.2 below) resulted in the occurrence being classified as a radiation event.

Five operating facilities were involved in the seven occurrences. Two of these five operating facilities experienced two unusual occurrences each; three facilities experienced one unusual occurrence each. Three unusual occurrences took place in facilities engaged in chemical operations; four unusual occurrences involved service facilities.

2.2 Radiation Events

The one unusual occurrence recorded during the fourth quarter that was classified as a radiation event involved an employee who was exposed to a quantity of tritium oxide while performing an operation at a Laboratory hood (Table 2.1, Item 2). The exposure occurred when tritium oxide was released to room atmosphere due to an inadequate air flow in the hood which was being used by the employee.

2.3 Preliminary Laser Survey

A preliminary survey at ORNL indicates that there are several groups using lasers currently and that we will probably see more of these devices at the Laboratory in the near future. Although lasers—a source of high intensity, monochromatic, coherent and highly collimated light—do not produce ionizing radiation, except as may be produced in the associated power supply, the types of hazards associated with lasers are closely allied with the type of hazards associated with radiation.

Applied Health Physics is initiating a program in which contacts will be made with all divisions regarding location, use, and hazard control of all lasers in their respective divisions.

[1] The method of classifying unusual occurrences is given in ORNL CF 63-9-8.

Table 2.1 Radiation Occurrences Tabulated for 4th Quarter, 1963

No.	Date	Facility(s) Involved	Division(s) Involved	Subject of Unusual Occurrence Report
1.	10-4-63	Bldg. 3019 (Cell 4)	Chem. Tech.	Personnel and Surface Contamination During Repair of Rod Vibrator on First Level of Cell # 4.
2.	10-28-63	Bldg. 4500-S (Rm. E-57)	Physics	Internal Exposure Received as Result of Tritium Release During Equipment Change in Hood.
3.	11-5-63	Bldg. 3019 (Rm. 210)	Anal. Chem.	Spill of Radioactive Materials During Transfer of Samples From Glove Box.
4.	11-12-63	Bldg. 3517	Isotopes	Radioactive Contamination Resulting From Removal of Manipulator From Cell # 13.
5.	11-14-63	Bldg. 3005 (East Room)	Operations	Release of Radioactive Gaseous Material During Removal of Pressurized Capsule From HB-3 of the LITR.
6.	12-11-63	Bldg. 3019 (Cell II)	Chem. Tech.	Personnel and Surface Contamination Resulting from Equipment Removal Operation in Cell II.
7.	12-17-63	Bldg. 3005 (Top Floor LITR)	Operations	Personnel and Surface Contamination Resulting from Drainage of Sample Carrier.

3.0 DOSIMETRY SECTION

3.1 Personnel Monitoring

3.1.1 External Dosimetry - No employee exceeded a recommended maximum quarterly dose during the last quarter of 1963. The highest exposure, in terms of per cent of a recommended maximum dose level, was a total body dose of 1.1 rem which represents 37 per cent of the recommended maximum quarterly dose of 3 rem. Only three individuals received a total body dose that equalled or exceeded 1/3 of the recommended maximum quarterly dose. The highest cumulative total body dose for the year 1963 was about 5 rem. The highest total body skin dose received during the quarter was about 2.6 rem which represents 26 per cent of the recommended maximum quarterly dose. A tabulation of exposures which equalled or exceeded one-third of the recommended limit is shown in Table 3.1.

3.1.2 Internal Dosimetry

Bio-Assays - Bio-assay results from samples submitted by the employee exposed to tritium (see Section 2.2, Radiation Events) indicated an estimated body deposition of approximately 86 mc—equivalent to about three years exposure at $(MPC)_a$ levels. The employee has been temporarily restricted from work with radioactive materials. The duration of the work restriction will be determined following the completion of studies of bio-assay data obtained from samples submitted by the employee. Three employees, all of whom have been under observation for several months, continued to have estimated bone burdens of Pu-239 which approximate 1/3 of the recommended body burden. No other cases involving a significant body burden developed during the fourth quarter.[1]

Whole Body Counter[2] - A total of 423 human counts on 406 persons was carried out by the staff of the whole body counting facility during the fourth quarter. Among the number counted, 97 individuals indicated measurable amounts of radioactivity above the averaged unexposed human background of about 20 nanocuries Cs-137. Table 3.2 gives the highest values of analyses performed by whole body counting techniques during the quarter.

3.2 Program Developments

3.2.1 Badge-Metering Program for Biology Division Visitors - Visitors to the Biology Division's facilities at Y-12 are now being issued an ORNL badge-meter which will improve the monitoring program at these facilities. The legend "Biology Visitor" and a serial number are included

[1]Action is taken to curtail an employee's exposure to internal emitters when measurements approach 30 per cent of a recommended maximum body burden.

[2]Data supplied by Health Physics Technology Section, B. R. Fish, Section Chief.

Table 3.1 Personnel Meter Exposure Summary—4th Quarter, 1963

Employee	Laboratory Division	Fourth Quarter Dose		Cumulative Dose for 1963	
		Skin of Total Body (rem)	Total Body (rem)	Skin of the Body (rem)	Total Body (rem)
A	Isotopes	1.2	1.1	4.7	3.6
B	Isotopes	1.2	1.0	6.2	5.1
C	Isotopes	1.3	1.0	2.5	2.1
D	Thermonuclear	0.9	0.9	4.8	4.3
E	Isotopes	1.9	0.9	6.0	4.3
F	Isotopes	2.2	0.9	6.2	4.2
G	Thermonuclear	0.9	0.9	4.1	4.0
H	Thermonuclear	0.8	0.8	4.9	4.8
I	Isotopes	0.9	0.7	6.2	4.9

Note: Table 3.1 is a list of exposures for employees whose recorded dose (underlined value) equals or exceeds approximately 1/3 of the recommended operating limits.

Table 3.2 Radioactivity Found in Laboratory Employees Investigated by Whole Body Counting Techniques During the Months of October, November and December, 1963

Isotope	Maximum Amount	~ % MPBB*
Cr-51	Trace	--
Co-58	12 nc	< 0.1%
Fe-59	Trace	--
Co-60	11 nc	0.11%
Zn-65	3 nc	< 0.1%
Se-75	Trace	--
Zr-95, Nb-95	11 nc	< 0.1%
Ru-106, Rh-106	36 nc	1.2%
Sb-125	9 nc	< .1%
I-131	73 nc	10.4%
Cs-137	69 nc	0.23%
Ce-144, Pr-144	Trace	--
Ra-226	Trace	--

*MPBB - Maximum Permissible Body Burden.

in the meter identification. In addition, monitoring control has been improved by requiring visitors to register upon entering the biology building.

3.2.2 Monitoring Instruments for Health Center - Engineering and design have been completed for improved instrumentation to be used by the Health Division for treatment of cases in which radioactive contamination is involved. The new design will improve the sensitivity of the instruments and will utilize detectors that are better adapted for medical purposes than the equipment presently available.

3.2.3 Modification of Dosimetry Reports to ORNL Divisions - All dosimetry reports, other than the weekly pocket meter report, have been changed so that personnel listings are tabulated by division rather than by departments within a division. As the reports were already being distributed to the divisions rather than to various departments, savings in time required for record keeping, report preparation, and distribution have been accomplished.

3.2.4 Service Data and Inventory of Radiation Monitoring Instruments - A cooperative program between Health Physics and the Instrumentation and Controls Division was initiated for providing inventory and service data statistics on stationary radiation monitoring instruments by electro data processing techniques. The system will be valuable in determining instrument reliability, detecting chronic faults, classifying service cost, and for predicting needed improvements or replacements. In addition, inventory information relative to instrument type, costs, and assignments will be made readily available.

3.2.5 Large-Area Alpha Scintillation Detector - The Radiation Detection Section of the I and C Division is designing, at the request of the Health Physics Division, a large area, alpha scintillation detector. The proposed new detector will have a sensitive surface area of about 460 cm^2 (6 in. x 12 in.), as compared to the sensitive surface area of about 100 cm^2 (4 in. x 4 in) available currently. The large area detector will provide considerable improvement in hand, foot, clothing, and laboratory area monitoring. Preference was given to a scintillation type detector rather than a proportional detector because: 1) it is not dependent upon counter gas with the associated tubing and attendant hazard; 2) it will operate at lower voltage; and 3) it utilizes simpler electronics than the gas proportional counter.

4.0 ENVIRONMENTAL MONITORING

4.1 Atmospheric Monitoring

The concentration of radioactivity in the air sampled by network stations located at the X-10 site and over the East Tennessee area continued the downward trend which started during the third quarter (Fig. 4.1). The average value for the fourth quarter for each monitoring network was approximately a factor of three lower than the average values measured during the third quarter of 1963. This downward trend was anticipated following peak concentrations from weapons debris in the spring of 1963. The monitoring network average values for the month of October are essentially the same as those reported by the USPHS Radiation Surveillance Network[1] (latest published data) for a number of cities located in the southeastern section of the United States.

The average weekly concentrations of radioactive materials in air sampled by the three ORNL air monitoring networks are shown in Table 4.1. The quarterly average for the LAM[2] network was 1.6×10^{-12} μc/cc with weekly values at individual monitoring stations ranging from a minimum of 0.36×10^{-12} μc/cc to a maximum of 5.2×10^{-12} μc/cc. Averages for the PAM[3] and RAM[4] networks were 1.0×10^{-12} μc/cc and 1.3×10^{-12} μc/cc respectively with weekly values ranging from a minimum of 0.29×10^{-12} μc/cc to a maximum of 2.9×10^{-12} μc/cc.

Atmospheric radioiodine, as measured by the PAM network, averaged about 0.01 pc/m^3, 0.003% $(MPC)_a$ for I-131, during the 4th quarter of 1963. The maximum levels were observed at the Gallaher, White Oak Dam, and Blair stations. The highest level was observed at the Gallaher station where the calculated concentration was 0.79 pc/m^3, 0.25% $(MPC)_a$ for I-131, when corrected for decay and averaged over the collection period of one week. The values observed correlated with a stack release at the Laboratory of 3191 millicuries of radioiodine.[5] Atmospheric conditions during the time of release were favorable for the released radioiodine to be carried to the stations where it was detected.

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[1] "Tabulation of Findings for October 1 - October 31, 1963, Inclusive, Public Health Service Radiation Surveillance Network", U. S. Department of Health, Education and Welfare, Public Health Service, Washington, D.C.

[2] LAM - Local Air Monitor (located at or near the X-10 site).

[3] PAM - Perimeter Air Monitor (located on the outer boundary of the AEC-controlled area).

[4] RAM - Remote Air Monitor (located from 12 to 75 miles from the X-10 site).

[5] "Summary of Waste Discharges, Week Ending 10-27-63", L. C. Lasher.

Table 4.1 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—4th Quarter, 1963

Week No.	LAM Network[a]	PAM Network[b]	RAM Network[c]
40	3.4×10^{-12} μc/cc	2.0×10^{-12} μc/cc	2.6×10^{-12} μc/cc
41	3.3	2.1	2.4
42	2.4	1.6	2.1
43	1.5	1.0	1.2
44	1.4	0.9	1.1
45	1.5	0.9	1.2
46	0.9	0.7	0.7
47	1.7	1.0	1.2
48	0.9	0.5	0.7
49	1.1	0.7	0.8
50	0.6	0.4	0.5
51	1.3	1.0	1.0
52	1.2	0.7	0.9
Average for Quarter	1.6×10^{-12} μc/cc	1.0×10^{-12} μc/cc	1.3×10^{-12} μc/cc
Average Year to Date	4.9×10^{-12} μc/cc	4.0×10^{-12} μc/cc	4.3×10^{-12} μc/cc
Average Last Year (1962)	3.7×10^{-12} μc/cc	3.6×10^{-12} μc/cc	4.3×10^{-12} μc/cc

[a]LAM - Local Air Monitor (located at or near the X-10 site).

[b]PAM - Perimeter Air Monitor (located on the outer boundary of the AEC-controlled area).

[c]RAM - Remote Air Monitor (located from 12 to 75 miles from the X-10 site).

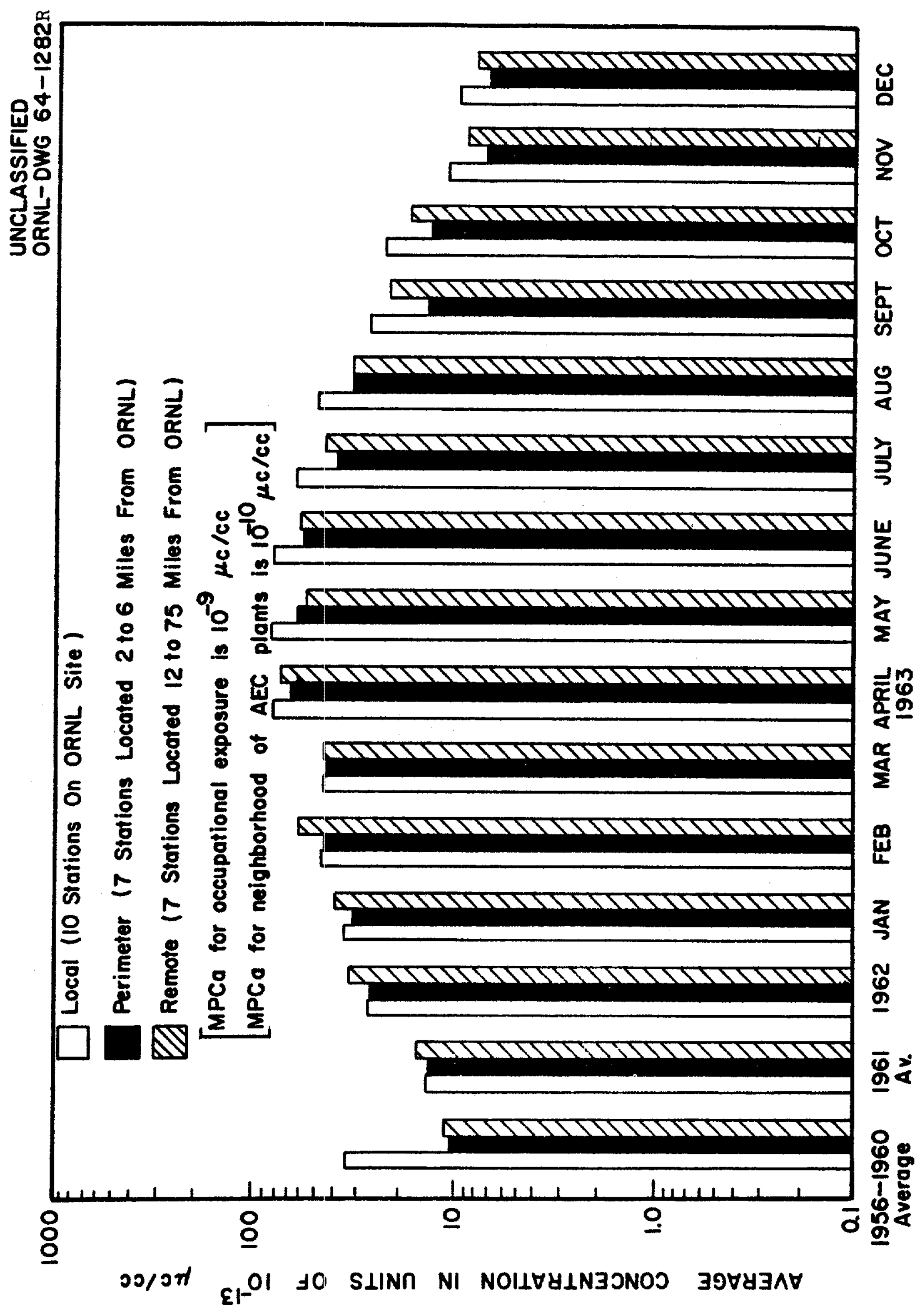

Fig. 4.1 Concentration Of Radioactive Materials in Air
(Filter Paper Data)

4.2 Fall-Out Measurements

Fall-out measurements (using the gummed paper technique)[6], as determined by the PAM and RAM networks, indicated a continuation of the downward trend noted during the first part of the year (Fig. 4.2). These two networks show a decrease in fall-out by a factor of two from the third quarter of 1963 (Table 4.2). However, the LAM network showed a corresponding increase by a factor of two from the previous quarter's measurements. The LAM network measurements, influenced by fall-out from local operations as well as from weapons debris, usually show higher values than are observed at the PAM and RAM networks when world-wide weapons fall-out is low.

4.3 Water Analysis

Rain Water - The quarterly average concentration of radioactivity in rain water collected at the station within the LAM network was 0.18×10^{-6} μc/ml. The PAM and RAM network averages were 0.15×10^{-6} μc/ml and 0.26×10^{-6} μc/ml respectively. The fourth quarter values are about 1/2 of the corresponding values measured during the previous quarter (Fig. 4.3). The fourth quarter values for individual stations are given in Table 4.3.

Clinch River Water - Approximately 43 curies of radioactive materials were discharged via White Oak Creek into the Clinch River during the fourth quarter of 1963. Discharges during the first, second, and third quarters were 290, 74, and 63 curies respectively. About 78 per cent of the radioactive materials present in White Oak Lake effluent was attributed to Ru-106 which enters White Oak Creek mainly from the seepage pit disposal system.[7] However, Ru-106 contributed to only about 19 per cent of the calculated maximum permissible concentration for drinking water, $(MPC)_w$, derived for the mixture of radionuclides known to be carried by White Oak Lake effluent as it passes into Clinch River waters at Clinch River Mile (CRM) 20.8. The isotopic distribution of the White Oak Lake effluent is given for the months of October, November, and December in Table 4.4. Assuming uniform mixing of White Oak Lake effluent with Clinch River water at the confluence of the two streams (CRM 20.8), the calculated monthly average gross beta concentrations in the Clinch River resulting from ORNL liquid waste discharges were as follows:

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[6] The gummed paper collector presents a collection surface of 1 square foot. Radioparticulates per square foot are determined by autoradiography.

[7] Monthly Reports - "Laboratory Facilities - Waste Disposal", L. C. Lasher.

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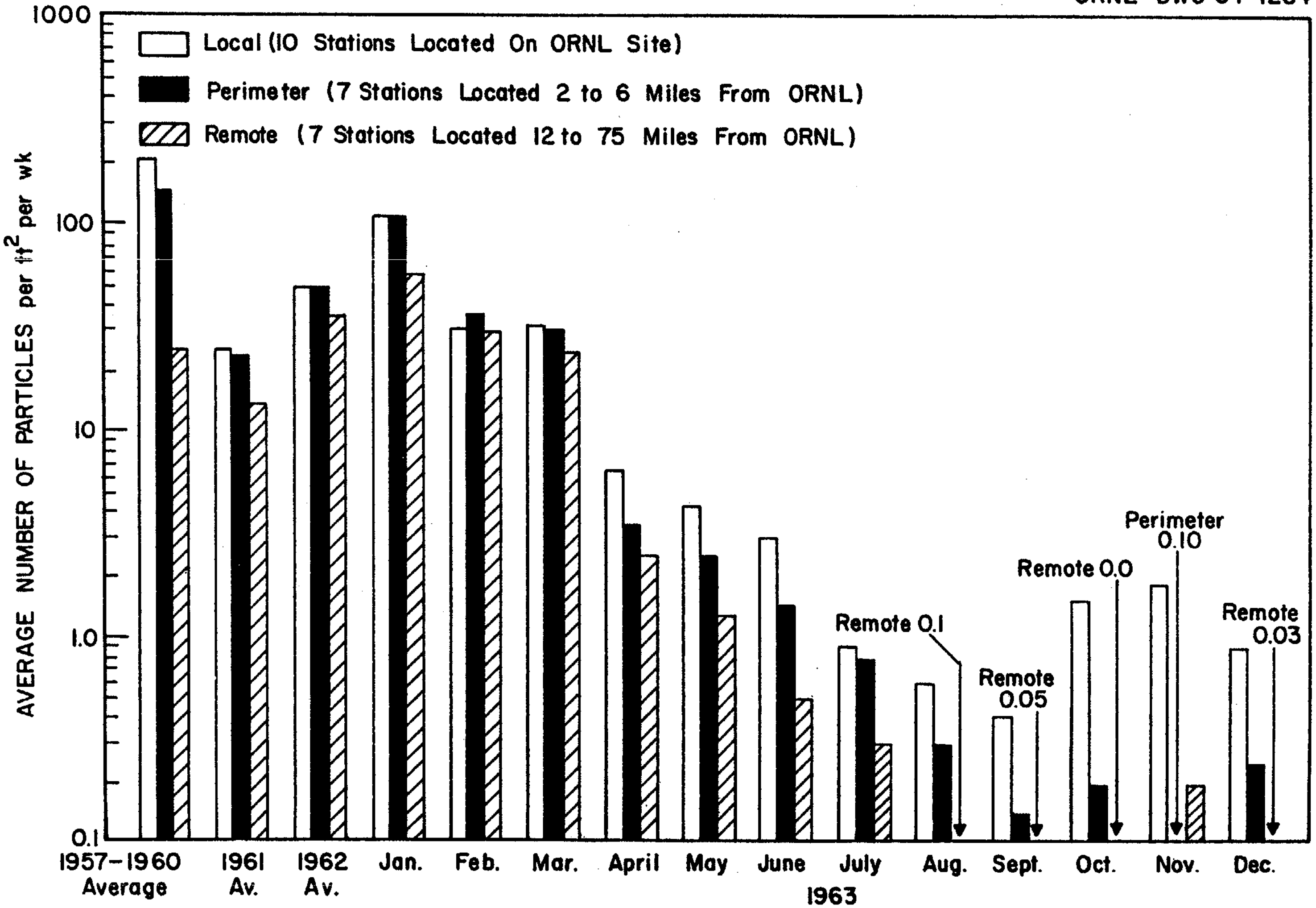

Fig. 4.2 Radioparticulate Fall-Out Measurements (Measured By Autoradiographic Techniques Using Gummed Paper Collectors)

Table 4.2 Radioparticulate Fall-Out Measurements Averaged Weekly From Gummed Paper Data—4th Quarter, 1963

Week No	LAM Network	PAM Network	RAM Network
40	1.3 particles/ft^2/wk	0.00 particles/ft^2/wk	0.00 particles/ft^2/wk
41	0.7	0.57	0.00
42	3.7	0.14	0.00
43	1.2	0.14	0.00
44	1.2	0.14	0.00
45	2.0	0.14	0.43
46	2.3	0.29	0.00
47	1.5	0.00	0.57
48	1.3	0.14	0.00
49	1.3	0.14	0.00
50	1.8	0.14	0.14
51	0.0	1.00	0.00
52	0.5	0.14	0.00
Average for Quarter	1.5	0.23	0.09

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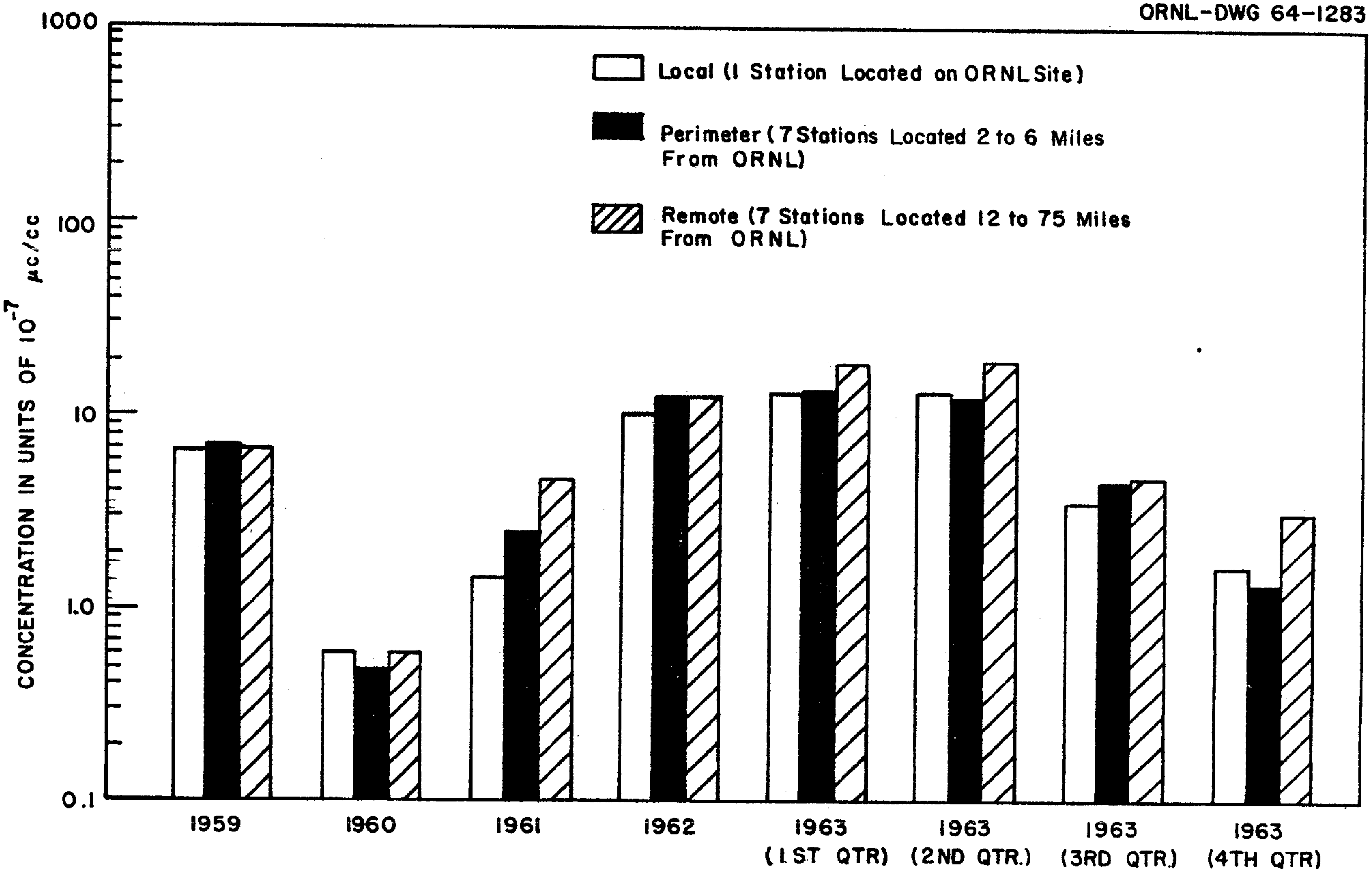

Fig 4.3 Concentration Of Radioactive Materials In Rain Water

Table 4.3 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—4th Quarter, 1963

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	0.18×10^{-6} μc/ml
	PAM Network	
HP-31	Kerr Hollow Gate	0.16×10^{-6} μc/ml
HP-32	Midway Gate	0.14
HP-33	Gallaher Gate	0.14
HP-34	White Oak Dam	0.22
HP-35	Blair Gate	0.12
HP-36	Turnpike Gate	0.12
HP-37	Hickory Creek Bend	0.17
Network Average		0.15×10^{-6} μc/ml
	RAM Network	
HP-51	Norris Dam	0.19×10^{-6} μc/ml
HP-52	Loudoun Dam	0.19
HP-53	Douglas Dam	0.17
HP-54	Cherokee Dam	0.16
HP-55	Watts Bar Dam	0.23
HP-56	Great Falls Dam	0.55
HP-57	Dale Hollow Dam	0.33
Network Average		0.26×10^{-6} μc/ml

Table 4.4 Radioisotopic Distribution in White Oak Lake Effluent—4th Quarter, 1963

Isotope	% of Total Beta Radioactivity		
	October	November	December
Ru^{106}	58	74	83
Zr^{95}	0.19	0.06	0.12
Nb^{95}	0.19	0.06	0.00
Ce^{144}	0.75	0.67	0.15
*TRE (less Ce^{144})	17	13	3.2
Cs^{137}	2.2	3.6	5.1
I^{131}	0.56	0.06	0.17
Ba^{140}	0.56	0.55	0.07
Co^{60}	5.4	4.4	6.1
Sr^{89}	1.9	0.39	0.20
Sr^{90}	13	3.8	1.9

*TRE-Total rare earths

Month	Concentration[8]	% $(MPC)_w$[9]
October	0.01×10^{-6} μc/ml	1.3
November	0.09×10^{-6} μc/ml	2.8
December	0.09×10^{-6} μc/ml	1.9
	Average	2.0

The average concentration of the major radioactive constituents in Clinch River water at CRM 20.8 resulting from Laboratory Waste releases is given in Table 4.5.

The measured average concentrations of radioactive materials in Clinch River water sampled at the ORGDP filtration plant intake (CRM 14.5) were as follows:

Month	Concentration	% $(MPC)_w$
October	0.015×10^{-6} μc/ml	4.3
November	0.08×10^{-6} μc/ml	5.7
December	0.10×10^{-6} μc/ml	7.6
	Average	5.9

A comparison of the per cent $(MPC)_w$, by months, for 1963 with values determined for the years 1956 through 1962 is shown in Fig. 4.4. The differences between the calculated values (computed for CRM 20.8) and the measured values (determined at CRM 14.5) are due, in part, to the presence of fall-out materials (primarily Sr-90)[10] in Clinch River water upstream from the point of entry of Laboratory wastes.

The concentration of Sr-90 and Ru-106 in Clinch River water at the ORGDP water filtration plant intake (CRM 14.5) is given in Table 4.6.

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[8] Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that may be carried by the river upstream from CRM 20.8.

[9] Weighted average $(MPC)_w$ for persons residing in the neighborhood of a controlled area calculated for the isotopic mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

[10] The average concentration of Sr-90 in Clinch River water CRM 41.5 (approximately 20 miles upstream from the point of entry of Laboratory wastes) was 0.14×10^{-8} μc/ml.

Table 4.5 Average Concentration of Major Radioactive Constituents in the Clinch River at Mile 20.8 Resulting from ORNL Waste Releases via White Oak Lake[a]—4th Quarter, 1963

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)					Gross Beta	$(MPC)_w$[b]	%
	Sr^{90}	Ce^{144}	Cs^{137}	$Ru^{103-106}$	Co^{60}	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
October	0.09	0.005	0.015	0.39	0.04	0.01	0.8	1.3
November	0.18	0.031	0.17	3.4	0.20	0.09	3.0	2.8
December	0.15	0.012	0.41	6.6	0.49	0.09	4.5	1.9

[a]Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter the river upstream from CRM 20.8.

[b]Weighted average $(MPC)_w$ for populations residing in the neighborhood of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

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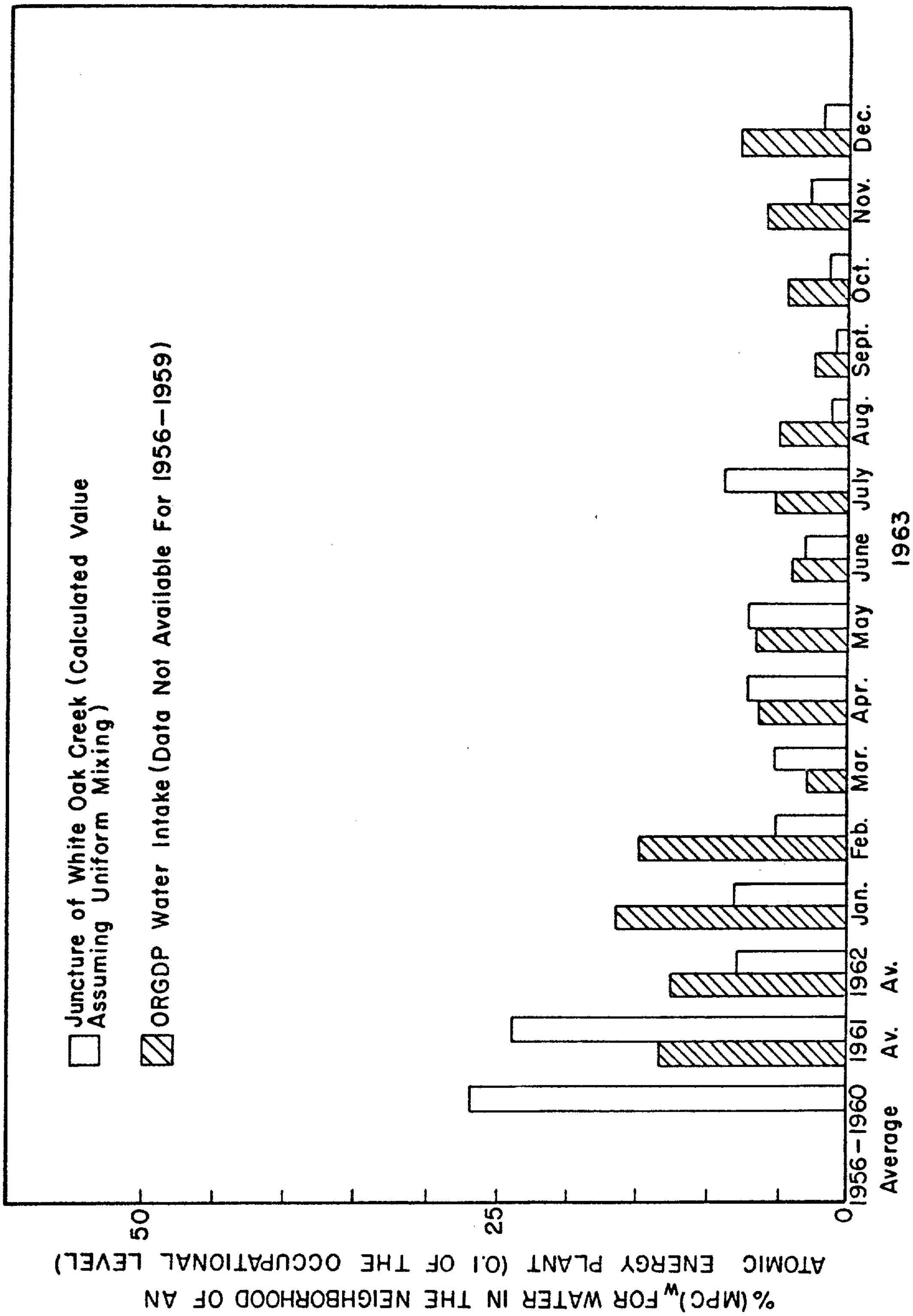

Fig. 4.4 Radioactive Content Of Clinch River Water

Table 4.6 Average Concentration[a] of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—4th Quarter, 1963

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)		Gross Beta	$(MPC)_w$[b]	%
	Sr^{90}	$Ru^{103-106}$	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
October	0.54	0.8	0.02	0.35	4.4
November	0.54	6	0.08	1.38	6.0
December	0.54	8	0.10	1.27	7.8

[a]Observed values based on analyses of monthly composited samples.

[b]Weighted average $(MPC)_w$ for populations in the vicinity of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

4.4 Background Measurements of Ionizing Radiation

The average background level recorded during the fourth quarter at 53 stations located on or near the X-10 site was 0.09 mR/hr. The background levels measured at individual stations ranged from a minimum of 0.012 mR/hr to a maximum of 2.5 mR/hr. The average level recorded at the five stations located around the perimeter of the AEC controlled area was 0.018 mR/hr.

From Table 4.7 it is observed that the average background level at the X-10 site was about eight times the level recorded in 1943; the fourth quarter average background level around the AEC controlled area perimeter was 50 per cent greater than the 1943 level. The average background levels for 1963, by quarters, and the yearly averages for 1959 through 1962 is presented in Fig. 4.5.

4.5 Raw Milk Analysis

Radioiodine was detected in only 20 per cent of the raw milk samples analyzed during the fourth quarter (the minimum detectable limit is 10 pc/l). The maximum concentration found in any one sample was 59 pc/l. Assuming 5 pc/l (1/2 the minimum detectable limit) to be the value for each sample below the minimum detectable limit, the average radioiodine concentration for all samples analyzed during the quarter was < 10 pc/l.

4.6 Cattle Thyroid Analysis

Thyroid glands taken from cattle pastured within a radius of 100 miles of the X-10 site were analyzed for radioiodine at an average rate of five thyroid specimens per week during the fourth quarter of 1963. Radioiodine was detected in only 14 of the 65 thyroids assayed (the limit of detection is about 1.0 pc/g tissue). The average radioiodine content found in the 14 specimens was 6.4 pc/g tissue; the maximum concentration observed was 17 pc/g tissue. The radioiodine concentrations measured in cattle thyroid tissue during the fourth quarter were about 1/100 of the levels measured in mid 1962 during the period of nuclear weapons testing. The fourth quarter data indicate that the deposition of radioiodine in the East Tennessee environment is now relatively insignificant.

Table 4.7 Background Measurements of Ionizing Radiation—4th Quarter, 1963

Area	Monthly Average for All Stations (mR/hr)			Quarterly Average for All Stations (mR/hr)	Year to Date Average All Stations (mR/hr)
	October	November	December		
X-10 Site (53 Stations)	0.084	0.103	0.082	0.090	0.104
AEC Controlled Perimeter (5 Stations)	0.020	0.018	0.015	0.018	0.026

Note: The radiation background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

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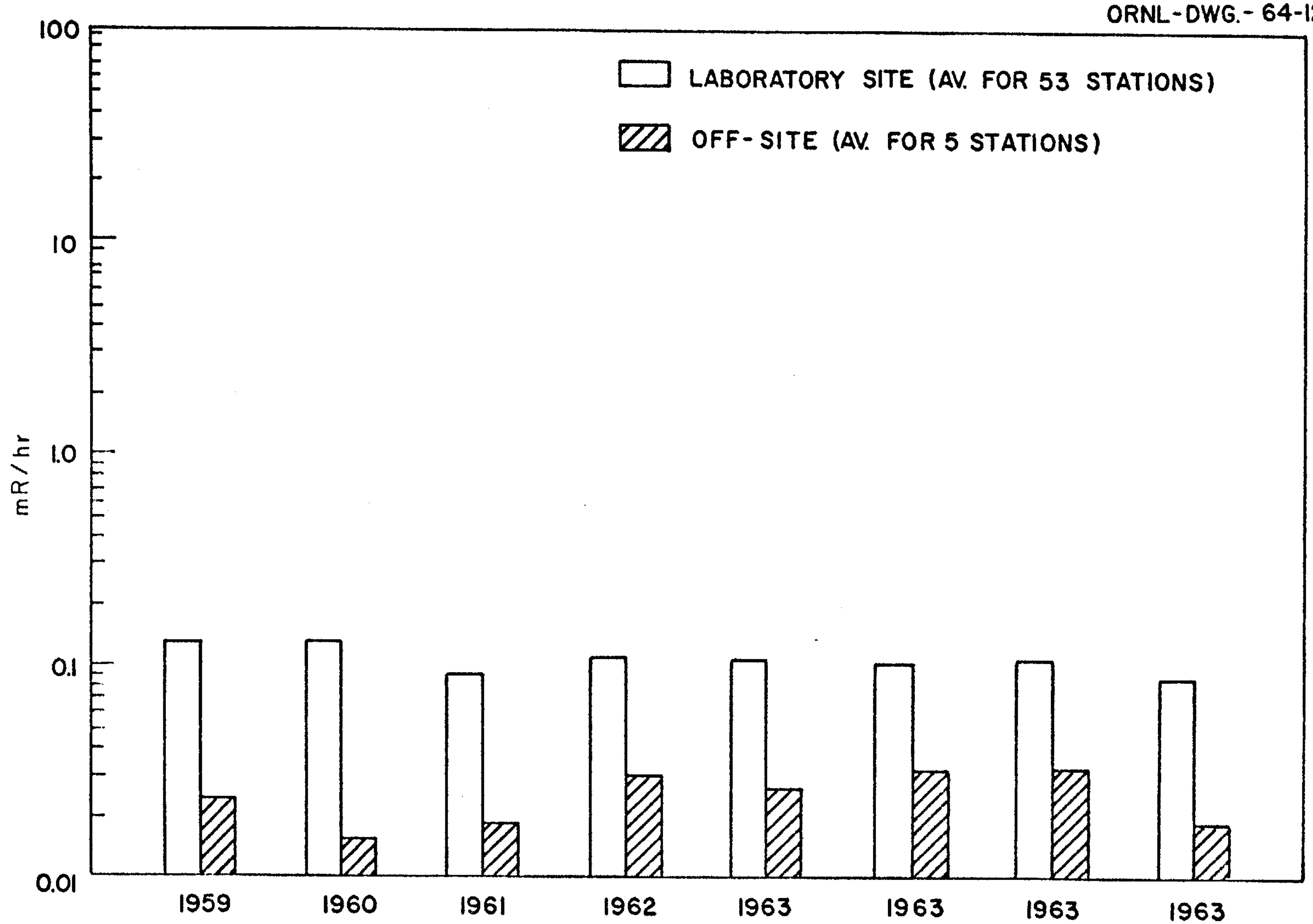

Fig. 4.5 Background Measurements Of Ionizing Radiation

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DATE: June 23, 1964

SUBJECT: APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY, FEBRUARY AND MARCH, 1964

TO: K. Z. Morgan - W. S. Snyder

FROM: D. M. Davis

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HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY, FEBRUARY AND MARCH, 1964

D. M. Davis, Section Chief

Data Contributed By:

H. H. Abee
R. L. Clark
E. D. Gupton
A. D. Warden

J. C. Hart, Editor

TABLE OF CONTENTS

1.0 MONITORING SUMMARY

1.1 Unusual Occurrences

Eleven unusual occurrences were recorded during the first quarter. There were 13 unusual occurrences recorded during the first quarter of last year, 1963. Only two of the eleven occurrences were classified as radiation events and these two were not of sufficient magnitude to require a report to the AEC. (See AEC Manual Chapter 0502 for definition of reportable incidents.)

1.2 Personnel Exposures

No employee exceeded 50 per cent of a recommended maximum quarterly external dose during the first quarter; and no employee received an internal exposure which resulted in a body burden of more than 50 per cent of the maximum permissible body burden.

1.3 Environmental Monitoring

The average concentration of radioactivity in the air, as measured by the LAM monitoring network, was 1.7×10^{-12} μc/cc [only a small fraction of the $(MPC)_a$]. The averages for the PAM and RAM networks were slightly less than the LAM monitoring network.

The highest average concentration for a milk sampling station was 62 pc/liter, [62 per cent of FRC Range II].

The average concentration of radioactive materials in Clinch River, as calculated from ORNL liquid waste discharges, was 8.2 per cent of the maximum permissible concentration for environments neighboring the controlled area [or 0.82 per cent of the maximum permissible concentration for occupational workers].

2.0 RADIATION SURVEY SECTION

2.1 Summary of Unusual Occurrences

Eleven unusual occurrences were recorded during the first quarter. Two of the occurrences were classified as radiation events; the remaining nine were classified as minor occurrences.[1] Five occurrences were attributed to faulty or inadequate equipment (Table 2.1, Items 1, 6, 8, 9 and 11); the other six were attributed to failure to use adequate care in some of the operations (Table 2.1, Items 2, 3, 4, 5, 7 and 10).

Contamination of an area and/or equipment occurred in five of the unusual occurrences. Personnel contamination was involved in eight of the occurrences. In four instances personnel and area or equipment contamination was involved.

Ten operating facilities were involved in the eleven occurrences. One operating facility experienced two unusual occurrences; nine facilities experienced one unusual occurrence each. Five unusual occurrences took place in facilities engaged primarily in chemical operations; six unusual occurrences involved service type facilities.

2.2 Radiation Events

One of the two unusual occurrences classified as a radiation event involved area, equipment, and personnel contamination and resulted from the unloading of a dumpster at the burial ground (Table 2.1, Item 3). One employee received a minor internal exposure (internal body deposition will not exceed Radiation Protection Guide)[2] and decontamination costs were about $1600.00. The second radiation event involved the accidental release of a considerable amount of ^{147}Pr during the transfer of the material from a shipping carrier to a storage vessel (Table 2.1, Item 4). Decontamination costs were about $650.00.

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[1] The method of classifying unusual occurrences is given in ORNL CF 63-9-8.

[2] AEC Manual Chapter 0502, "Reporting and Investigating Accidents and Radiation Exposures".

Table 2.1 Radiation Occurrences Tabulated for 1st Quarter, 1964

No.	Date	Facility(s) Involved	Division(s) Involved	Subject of Unusual Occurrence Report
1.	1-3-64	Bldg. 3019	Anal. Chem.	Personnel contamination resulting from an operation involving the stirring of a solution containing nitric acid and U-233, U-232 with its decay products.
2.	1-5-64	Bldg. 3077 (LITR Trane Cooler)	Operations	Personnel contamination resulting from the repairing of water leak in the LITR Trane Cooler.
3.*	1-6-64	Burial Ground # 5	P and E	Personnel and surface contamination during the emptying of a dumpster pan containing radioactive waste.
4.*	1-9-64	Bldg. 3517 (Cell # 15)	Isotopes	Personnel and surface contamination during the transfer of solution from a shipping carrier to a storage vessel.
5.	1-22-64	Bldg. 3025 (Cell access area)	Operations	Personnel contamination involving puncture wound received while decontaminating an analytical balance.
6.	1-24-64	Bldg. 7503	Insp. Engin.	Accidental release of ^{192}Ir source from radiographic camera.
7.	1-31-64	Bldg. 3038	Isotopes	Personnel and surface contamination resulting from handling grossly contaminated carrier.
8.	2-20-64	Bldg. 3019 RM. 211	Chem. Tech.	Shattering of plate glass panel in glove box due to excessive vacuum on system.
9.	3-4-64	Bldg. 3005 (East Room)	Operations	Radioactive surface contamination resulting from the insertion of a sample into the pneumatic tube system.
10.	3-4-64	Bldg. 3019	Chem. Tech.	Personnel contamination during performance of work at a decontamination sink.
11.	3-18-64	Bldg. 3504	Health Physics	Personnel contamination and minor hand laceration received while tightening cap on sample bottle.

*These two were classified as "radiation events".

3.0 DOSIMETRY SECTION

3.1 Personnel Monitoring

3.1.1 External Dosimetry - No employee exceeded a recommended maximum quarterly dose during the first quarter of 1964. The highest exposure, in terms of per cent of a recommended maximum dose level, was a total body dose of 1.3 rem which represents 43 per cent of the recommended quarterly dose of 3 rem. Only three individuals received a total body dose that equalled or exceeded 1/3 of the recommended maximum quarterly dose. The highest total body skin dose received during the quarter was 3.0 rem, which is 30 per cent of the recommended maximum quarterly limit. A tabulation of the ten highest personnel exposures is shown in Table 3.1.

3.1.2 Internal Dosimetry

Bio-Assays - No employee received an internal exposure which resulted in a body burden of more than 50 per cent of the maximum permissible body burden. Analyses of body fluids submitted by three employees exposed to ^{90}Sr indicate that continued surveillance will be required for the next several weeks. Urine sampling of an employee exposed to tritium is continuing to show a decrease to acceptable levels (see AHP Quarterly Report, ORNL CF 64-3-3). Three employees, all of whom have been under observation for several months, continue to show estimated bone burdens of ^{239}Pu which approximate 1/3 of the recommended body burden. No other cases involving a significant body burden developed during the first quarter.[1]

Whole Body Counter[2] - A total of 421 human counts on 364 persons was carried out by the staff of the Whole Body Counting Facility during the first quarter. Among the number counted, 101 individuals indicated measurable amounts of radioactivity above the averaged unexposed human background of about 20 nanocuries ^{137}Cs. Table 3.2 gives the highest values of analyses performed by whole body counting techniques during the quarter.

3.2 Program Developments

3.2.1 ORNL Whole Body Counter Program - An Electro Data Processing (EDP) program for tabulation of In Vivo Gamma Spectrometer (IVGS) data was initiated during the first quarter. This program should be completed, tested, and put in operation during the second quarter.

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[1]Action is taken to curtail an employee's exposure to internal emitters when measurements approach 30 per cent of a recommended maximum body burden.

[2]Data supplied by Health Physics Technology Section, B. R. Fish, Section Chief.

3.2.2 Quarterly Bio-Assay Summary - A modification of the weekly Bio-Assay Sample Status Report was outlined for programming during this quarter. The new program will provide a quarterly summary of bio-assay data for distribution during the next quarter.

3.2.3 HP Stationary Instrument Program - An EDP program for providing inventory and service data information on stationary radiation monitoring instruments was outlined during the first quarter. The programming phase is expected to be completed during the second quarter.

Table 3.1 Personnel Meters Exposure Summary—1st Quarter, 1963

Employee	Laboratory Division	First Quarter Dose		Cumulative Dose for 1964	
		Skin of Total Body (rem)	Total Body (rem)	Skin of the Body (rem)	Total Body (rem)
A	Isotopes	1.4	<u>1.3</u>	1.4	<u>1.3</u>
B	Isotopes	1.5	<u>1.2</u>	1.5	<u>1.2</u>
C	Isotopes	1.4	<u>1.1</u>	1.4	<u>1.1</u>
D	Isotopes	1.3	1.0	1.3	1.0
E	Isotopes	1.1	1.0	1.1	1.0
F	Isotopes	1.5	0.9	1.5	0.9
G	Chem. Tech.	1.0	0.9	1.0	0.9
H	Isotopes	1.3	0.9	1.3	0.9
I	Isotopes	1.1	0.9	1.1	0.9
J	Isotopes	2.8	0.9	2.8	0.9

Note: Table 3.1 is a list of the ten highest exposure doses for employees; the underlined values are those which exceed approximately 1/3 of the recommended operating limits.

Table 3.2

Isotopes Found and Maximum Amounts Detected

Isotope	No. of Persons	Maximum Amount	Approximate Per Cent MPBB
^{51}Cr	8	6 nc	< .001%
^{58}Co	18	6 nc	< .1
^{60}Co or ^{59}Fe	8	15 nc	< .1%
^{75}Se	10	29 nc	< .1%
^{90}Sr - ^{90}Y	10	689 nc	< 50%
^{95}Zr - ^{95}Nb	35	31 nc	.155%
^{106}Ru - ^{106}Rh	17	26 nc	1.3%
^{125}Sb	14	646 nc	1.6%
^{131}I	6	22 nc	3.1%
^{137}Cs	55	135 nc	.67%

4.3 Rain Water Analyses

Rain Water - The quarterly average concentration of radioactive materials deposited in rain water collected within the LAM network was 0.14×10^{-6} μc/ml. The PAM and RAM network averages were 0.16×10^{-6} μc/ml and 0.26×10^{-6} μc/ml respectively (Table 4.3). These values are about the same as the corresponding values measured during the fourth quarter of 1963. The concentration of radioactive materials in rain water measured at all three networks for the years 1959-1963 and the first quarter of 1964 are presented graphically in Fig. 4.3.

Clinch River Water - Approximately 127 curies of radioactive materials were discharged via White Oak Creek into the Clinch River during the first quarter of 1964. About 82 per cent of the radioactive materials in White Oak Lake effluent was attributed to ^{106}Ru which enters White Oak Creek mainly from the seepage pit disposal system.[6] However, ^{106}Ru contributed only about 20 per cent to the calculated maximum permissible concentration for drinking water, $(MPC)_w$, derived for the mixture of radionuclides known to be carried by White Oak Lake effluent as it passes into Clinch River water at Clinch River Mile (CRM) 20.8. The isotopic distribution of the White Oak Lake effluent is given for the months of January, February, and March in Table 4.4. Assuming uniform mixing of White Oak Lake effluent with Clinch River water at the confluence of the two streams (CRM 20.8) the calculated monthly gross beta concentrations in the Clinch River resulting from ORNL liquid waste discharges were as follows:

Month	Concentration[7]		$\%(MPC)_w$[8]
January	0.29×10^{-6} μc/ml		6.4
February	0.27×10^{-6} μc/ml		8.6
March	0.35×10^{-6} μc/ml		9.7
		Average	8.2

The average concentration of the major radioactive constituents in Clinch River water at CRM 20.8 resulting from Laboratory waste releases is given in Table 4.5.

The measured average concentrations of radioactive materials in Clinch River water sampled at the ORGDP filtration plant intake (CRM 14.5) were as follows:

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[6]Monthly Reports - "Laboratory Facilities - Waste Disposal", L. C. Lasher.

[7]Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that may be carried by the river upstream from CRM 20.8.

[8]Weighted average $(MPC)_w$ for persons residing in the neighborhood of a controlled area calculated for the isotopic mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

4.0 ENVIRONMENTAL MONITORING

4.1 Atmospheric Monitoring

The concentration of radioactivity in the air sampled by network stations located at the X-10 site and over the East Tennessee area was approximately the same during the first quarter 1964 as was measured during the fourth quarter 1963.

The average weekly concentrations of radioactive materials in air sampled by the three ORNL air monitoring networks are shown in Table 4.1. The quarterly average for the LAM[1] network was 1.7 x 10^{-12} µc/cc with weekly values at individual monitoring stations ranging from a minimum of 0.42 x 10^{-12} µc/cc to a maximum of 7.1 x 10^{-12} µc/cc. Averages for the PAM[2] and RAM[3] networks were 1.0 x 10^{-12} µc/cc and 1.3 x 10^{-12} respectively with weekly values ranging from a minimum of 0.32 x 10^{-12} µc/cc to a maximum of 2.3 x 10^{-12} µc/cc.

Atmospheric radioiodine, as measured by the PAM network, averaged about 0.05 x 10^{-12} µc/cc, or 0.017 per cent of the $(MPC)_a$ for ^{131}I, during the first quarter of 1964. The highest average concentration during any one week for all stations was 0.39 x 10^{-12} µc/cc and this occurred during the week which began March 16, 1964. The concentrations observed at individual stations during this particular week ranged from a low of .008 x 10^{-12} µc/cc to a high of 0.85 x 10^{-12} µc/cc; the lowest concentration was measured at the Medway station (PAM 32); the highest concentration was measured at the White Oak Dam station (PAM 34). During the week of highest concentration about 28 curies of radioiodine were released from the 3039 off-gas stack.[4]

4.2 Fall-Out Measurements

Fall-out measurements, as determined by the LAM, PAM and RAM networks from gummed paper techniques,[5] indicate that the low fall-out levels measured during the last quarter of 1963 continued through the first quarter of 1964 (Table 4.2). Fall-out levels observed at all three networks during the first quarter of 1964 were about a factor of ten lower than the average levels observed during 1963 (Fig. 4.2).

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[1]LAM - Local Air Monitor (located at or near the X-10 site).

[2]PAM - Perimeter Air Monitor (located on the outer boundary of the AEC-controlled area).

[3]RAM - Remote Air Monitor (located from 12 to 75 miles from the X-10 site).

[4]"Summary of Waste Discharges, Week Ending 3-22-64", L. C. Lasher.

[5]The gummed paper collector presents a collection surface of 1 square foot. Radioparticulates per square foot are determined by autoradiography.

Month	Concentration	$\%(MPC)_w$ [8]
January	0.17×10^{-6} μc/ml	7.0
February	0.10×10^{-6} μc/ml	5.6
March	0.15×10^{-6} μc/ml	7.2
	Average	6.6

A comparison of the per cent $(MPC)_w$, by months, for the first quarter of 1964 with values determined for the years 1956 through 1963 is shown in Fig. 4.4.

The concentration of ^{90}Sr and ^{106}Ru in Clinch River water at the ORGDP water filtration plant intake (CRM 14.5) is given in Table 4.6.

The highest concentration of ^{90}Sr in Clinch River water was observed during the month of March (See Tables 4.5 and 4.6). The highest concentrations were caused primarily by a lower average flow in the Clinch River during the month of March. The White Oak Lake effluent was diluted by a factor of 54 in March compared to 197 in January and 146 in February.

4.4 Background Measurements of Ionizing Radiation

The average background level recorded during the first quarter at 53 stations located on or near the X-10 site was 0.068 mR/hr (Table 5.7). The background levels measured at individual stations ranged from a minimum of 0.012 mR/hr to a maximum of 1.25 mR/hr. The average level recorded at the five stations located around the perimeter of the AEC controlled area was 0.014 mR/hr. The average background level determined for the first quarter and for the years 1959 through 1963 is given in Fig. 4.5.

4.5 Raw Milk Analysis

Raw milk samples, collected weekly at each of the seven milk sampling stations located on the fringe of Oak Ridge area (Fig. 4.6), are analyzed for radioiodine. Four additional stations, more remotely located with respect to Oak Ridge Operations, are sampled at the rate of one station per week.

During the first quarter, the average radioiodine concentration in the milk collected at all stations was 26 pc/l. The highest average weekly concentration observed at any one station was 62 pc/l; the highest concentration observed in any one milk sample was 278 pc/l. (FRC Range II for ^{131}I is 10 to 100 pc/day.)[9] This high concentration occurred in a milk sample collected at one of the sampling stations located on the fringe of the Oak Ridge Area the week following a release of approximately 28 curies of radioiodine from the 3039 off-gas stack.

4.6 Cattle Thyroid Analysis

A total of 23 cattle thyroids was assayed for radioiodine content during the quarter. Only two samples gave values of radioiodine that were significantly different from zero. (The lower limit of detection is approximately 1.0 pc/g of tissue). The two values detected that were significant were 6.4 pc/g and 5.7 pc/g. These relatively negative results indicate that the deposition of radioiodine in the East Tennessee area was insignificant; however, the milk monitoring data give a positive indication that airborne radioiodine continues to be deposited in the local area. The two types of data are not necessarily expected to correlate because of the difference in the location of sampling stations. Although cattle thyroid sampling for the most part gave negative results during this period, this method of sampling is considered to be of value because (1) it is one to two orders of magnitude more sensitive than other methods, (2) it indicates areas in which milk and/or grass sampling should be carried out and, (3) in case of an emergency or high fallout levels from weapons tests this technique is a continuing operation and available as an immediate adjunct to other monitoring methods.

[9] "Background Material for the Development of Radiation Protection Standards", Staff Report of the Federal Radiation Council, Report No. 2, September 1961.

Table 4.1 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—1st Quarter, 1964

Week No.	LAM Network[(a)]	PAM Network[(b)]	RAM Network[(c)]
1	1.5×10^{-12} μc/cc	0.9×10^{-12} μc/cc	1.2×10^{-12} μc/cc
2	0.8	0.5	0.5
3	1.5	1.0	1.2
4	1.8	0.9	1.1
5	2.2	1.2	1.9
6	1.1	0.6	0.9
7	2.0	1.2	1.3
8	1.3	0.9	1.0
9	1.3	0.9	1.1
10	1.8	1.1	1.3
11	2.3	1.2	1.6
12	2.4	1.3	1.6
13	2.6	1.3	1.7
Average for Quarter	1.7×10^{-12} μc/cc	1.0×10^{-12} μc/cc	1.3×10^{-12} μc/cc
Average Year to Date	1.7×10^{-12} μc/cc	1.0×10^{-12} μc/cc	1.3×10^{-12} μc/cc
Average Last Year (1963)	4.9×10^{-12}	4.0×10^{-12} μc/cc	4.3×10^{-12} μc/cc

[a]LAM - Local Air Monitor located at or near the ORNL site.

[b]PAM - Perimeter Air Monitor located on the outer boundary of the AEC-controlled area.

[c]RAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

Table 4.2 Radioparticulate Fall-Out Measurements Averaged Weekly From Gummed Paper Data—1st Quarter, 1964

Week No	LAM Network	PAM Network	RAM Network
1	1.7 particles/ft^2/wk	0.00 particles/ft^2/wk	0.14 particles/ft^2/wk
2	1.3	1.00	1.00
3	0.7	0.14	0.29
4	3.10	0.14	0.00
5	0.2	0.14	0.00
6	0.5	0.14	0.14
7	2.0	0.00	0.00
8	0.7	0.14	0.00
9	0.6	0.57	0.00
10	0.8	0.00	0.00
11	0.7	0.00	0.00
12	0.8	0.00	0.00
13	0.5	0.00	0.14
Average for Quarter	1.5 particles/ft^2/wk	0.23 particles/ft^2/wk	0.09 particles/ft^2/wk
Average Year to Date	1.1 particles/ft^2/wk	0.48 particles/ft^2/wk	0.13 particles/ft^2/wk
Average Last Year (1963)	17 particles/ft^2/wk	16 particles/ft^2/wk	10 particles/ft^2/wk

Table 4.3 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—1st Quarter, 1964

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	0.14×10^{-6} μc/ml
	PAM Network	
HP-31	Kerr Hollow Gate	0.15×10^{-6} μc/ml
HP-32	Midway Gate	0.18
HP-33	Gallaher Gate	0.16
HP-34	White Oak Dam	0.15
HP-35	Blair Gate	0.15
HP-36	Turnpike Gate	0.17
HP-37	Hickory Creek Bend	0.19
Network Average		0.15×10^{-6} μc/ml
	RAM Network	
HP-51	Norris Dam	0.34×10^{-6} μc/ml
HP-52	Loudoun Dam	0.15
HP-53	Douglas Dam	0.20
HP-54	Cherokee Dam	0.32
HP-55	Watts Bar Dam	0.19
HP-56	Great Falls Dam	0.32
HP-57	Dale Hollow Dam	0.29
Network Average		0.26×10^{-6} μc/ml

Table 4.4 Radioisotopic Distribution in White Oak Lake Effluent—1st Quarter, 1964

Isotope	% of Total Beta Radioactivity		
	January	February	March
^{106}Ru	83	80	82
^{95}Zr	0.02	0.02	0.04
^{95}Nb	0.00	0.005	0.00
^{144}Ce	0.07	0.10	0.06
TRE (less ^{144}Ce)*	4.35	7.07	3.84
^{137}Cs	4.97	1.78	2.73
^{131}I	0.11	0.05	0.02
^{140}Ba	0.11	0.05	0.02
^{60}Co	4.60	7.49	8.05
^{89}Sr	0.25	0.31	0.30
^{90}Sr	2.18	2.99	2.95

*TRE-Total rare earths

Table 4.5 Average Concentration of Major Radioactive Constituents in the Clinch River at Mile 20.8 Resulting from ORNL Waste Releases via White Oak Lake[a]—1st Quarter, 1964

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)					Gross Beta	$(MPC)_w$[b]	%
	^{90}Sr	^{144}Ce	^{137}Cs	$^{103-106}Ru$	^{60}Co	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
January	0.34	0.01	0.78	13	0.73	0.29	4.5	6.4
February	0.44	0.03	0.26	12	1.1	0.27	3.1	8.6
March	0.83	0.002	0.77	23	2.2	0.35	3.6	9.7

[a]Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter the river upstream from CRM 20.8.

[b]Weighted average $(MPC)_w$ for populations residing in the neighborhood of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 4.6 Average Concentration[a] of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—1st Quarter, 1964

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)		Gross Beta	$(MPC)_w$[b]	%
	^{90}Sr	$^{103-106}Ru$	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
January	0.59	14	0.17	2.4	7.0
February	0.45	8	0.10	1.7	5.6
March	0.63	12	0.15	2.0	7.2

[a]Observed values based on analyses of monthly composited samples.

[b]Weighted average $(MPC)_w$ for populations in the vicinity of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 4.7 Background Measurements of Ionizing Radiation—1st Quarter, 1964

Area	Monthly Average for All Stations (mR/hr)			Quarterly Average for All Stations (mR/hr)	Year to Date Average All Stations (mR/hr)
	January	February	March		
Laboratory Site (53 Stations)	0.076	0.052	0.076	0.068	0.068
Off-Site (Oak Ridge Controlled Area) (5 Stations)	0.014	0.015	0.014	0.014	0.014

Note: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

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ORNL-DWG 64-1282R2

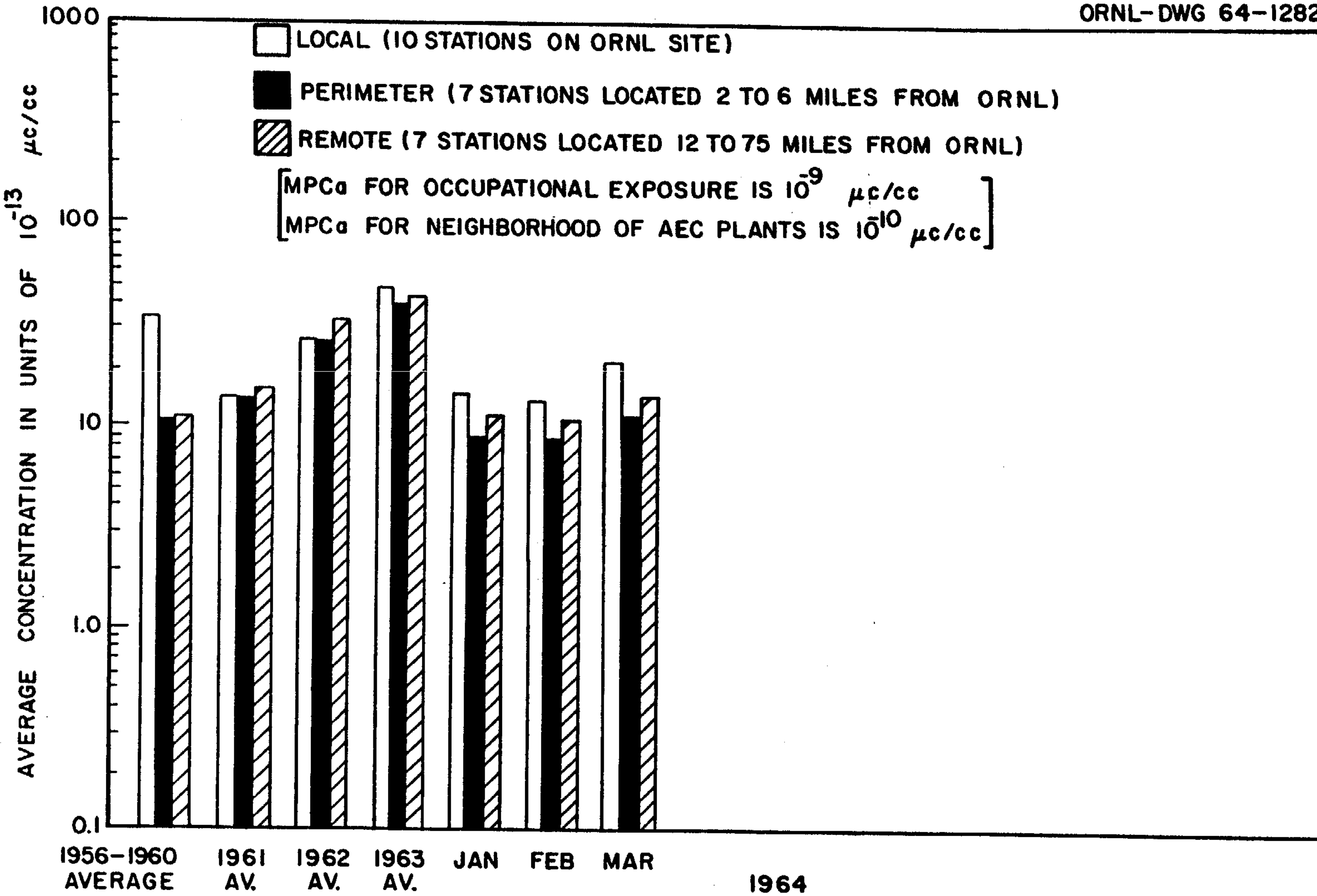

FIG. 4.1 CONCENTRATION OF RADIOACTIVE MATERIALS IN AIR
(FILTER PAPER DATA)

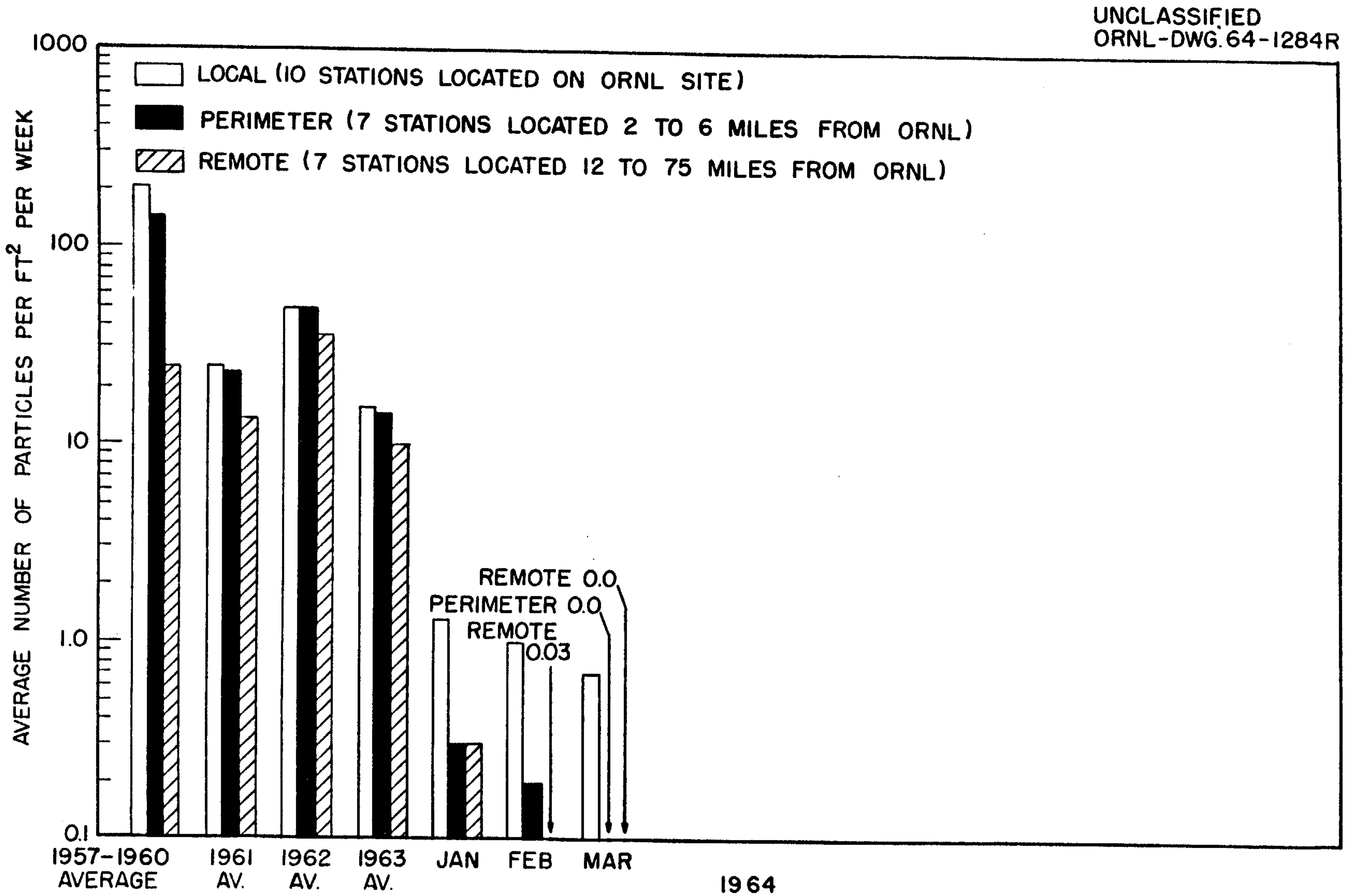

FIG. 4.2 RADIOPARTICULATE FALL-OUT MEASUREMENTS (MEASURED BY AUTORADIOGRAPHIC TECHNIQUES USING GUMMED PAPER COLLECTORS)

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ORNL – DWG. 64-1283R

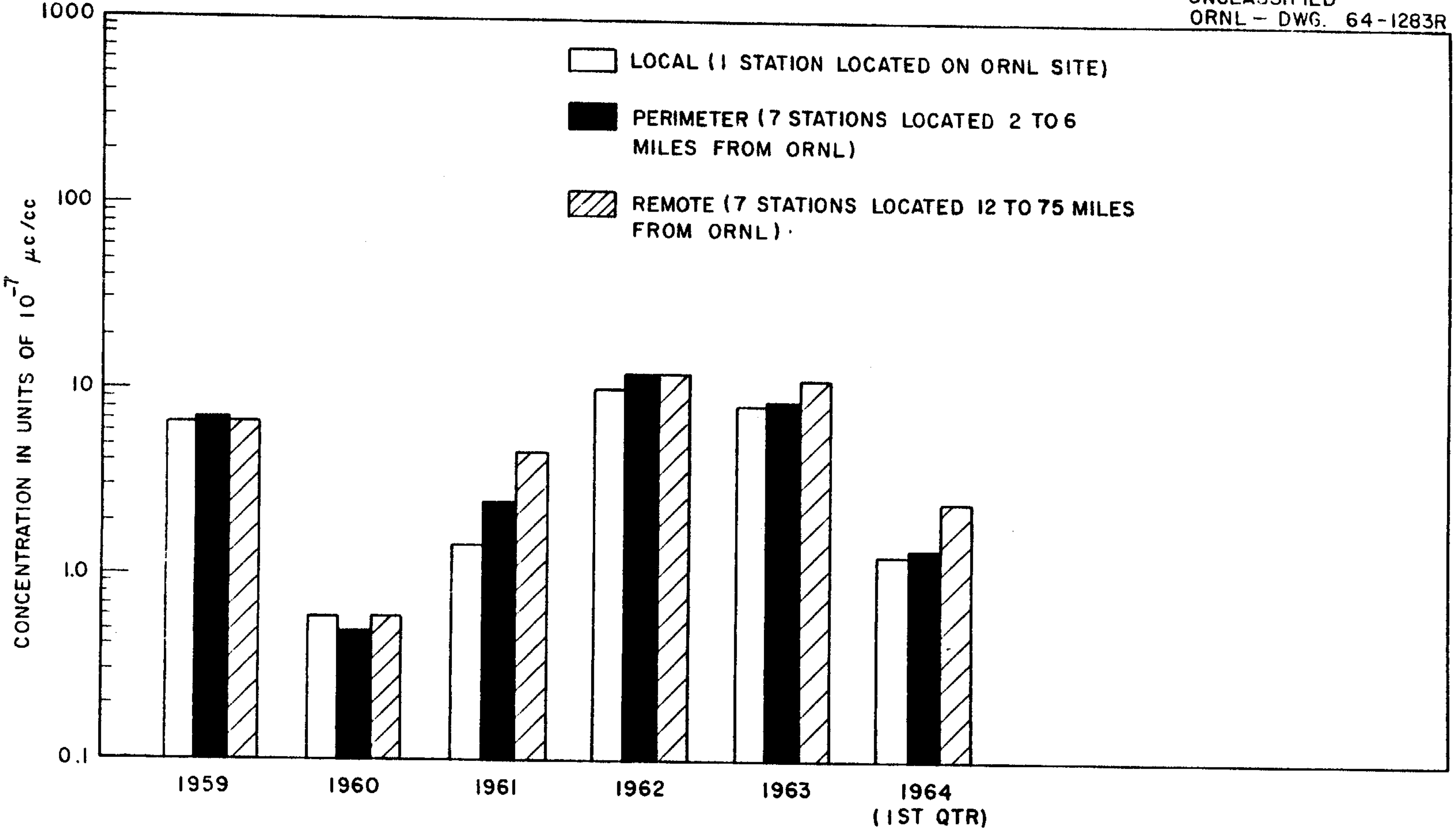

FIG. 4.3 CONCENTRATION OF RADIOACTIVE MATERIALS IN RAIN WATER

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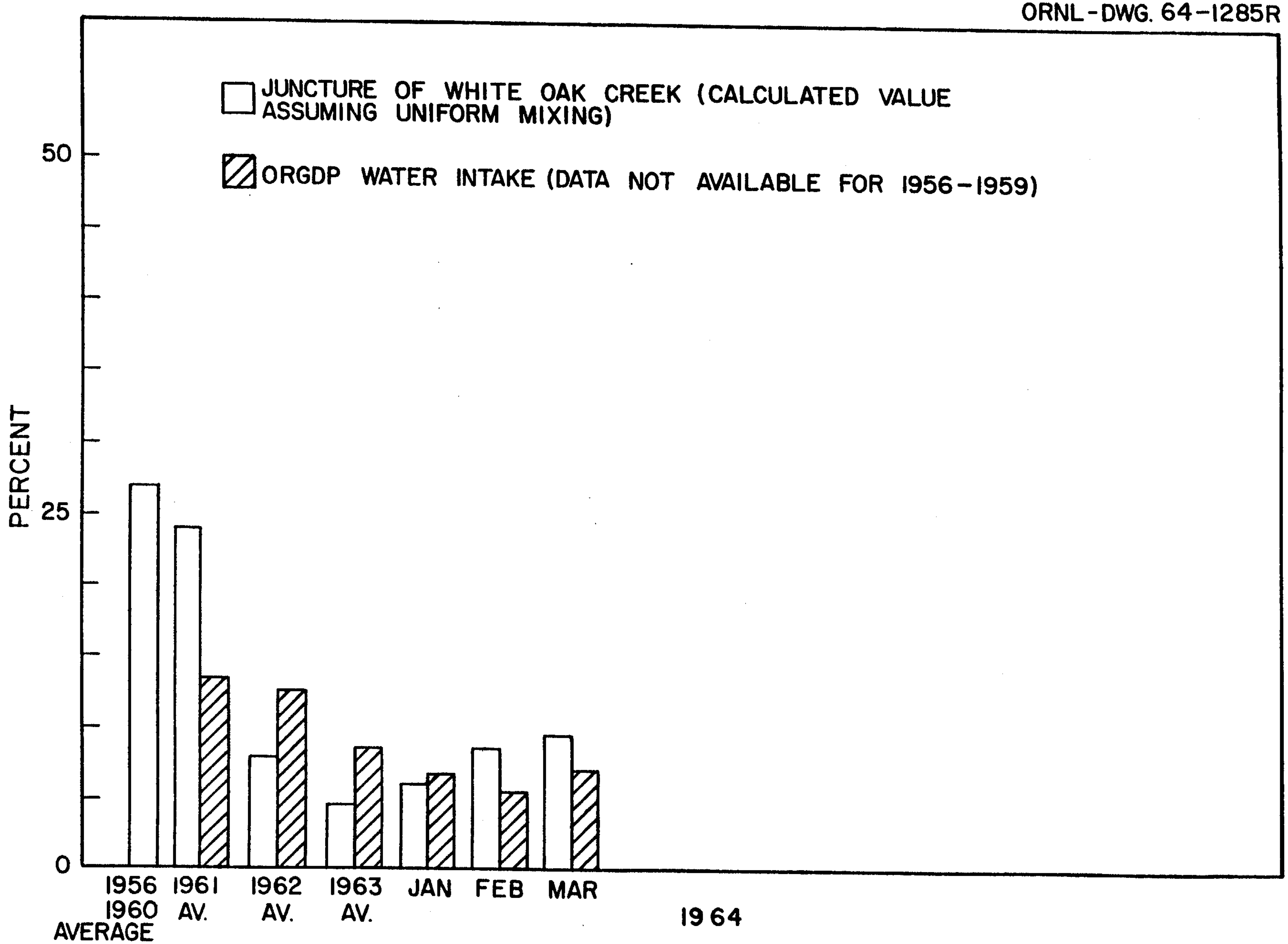

FIG. 4.4 % $(MPC)_w$ OF RADIOACTIVITY IN CLINCH RIVER WATER

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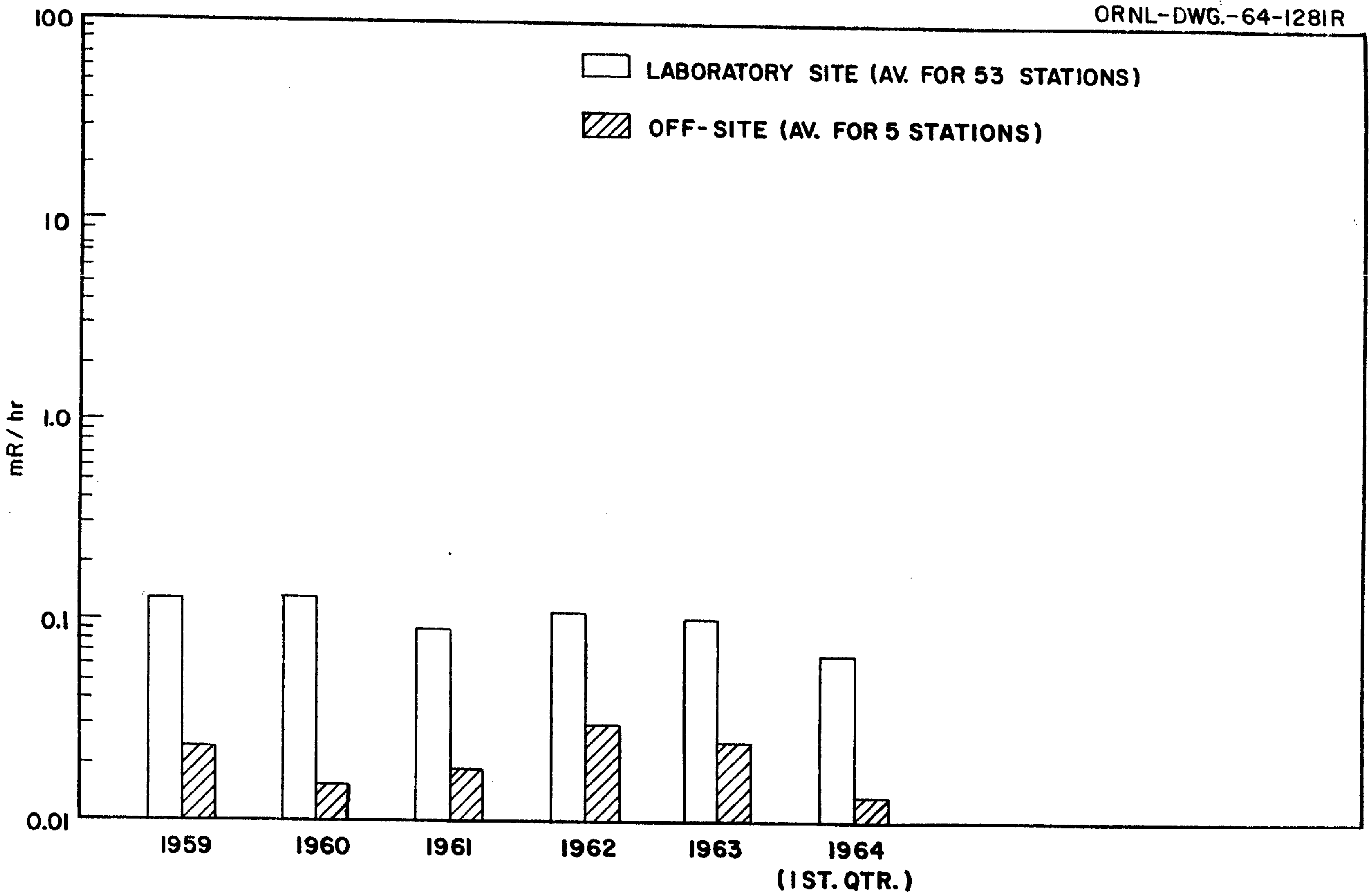

FIG. 4.5 BACKGROUND MEASUREMENTS OF IONIZING RADIATION

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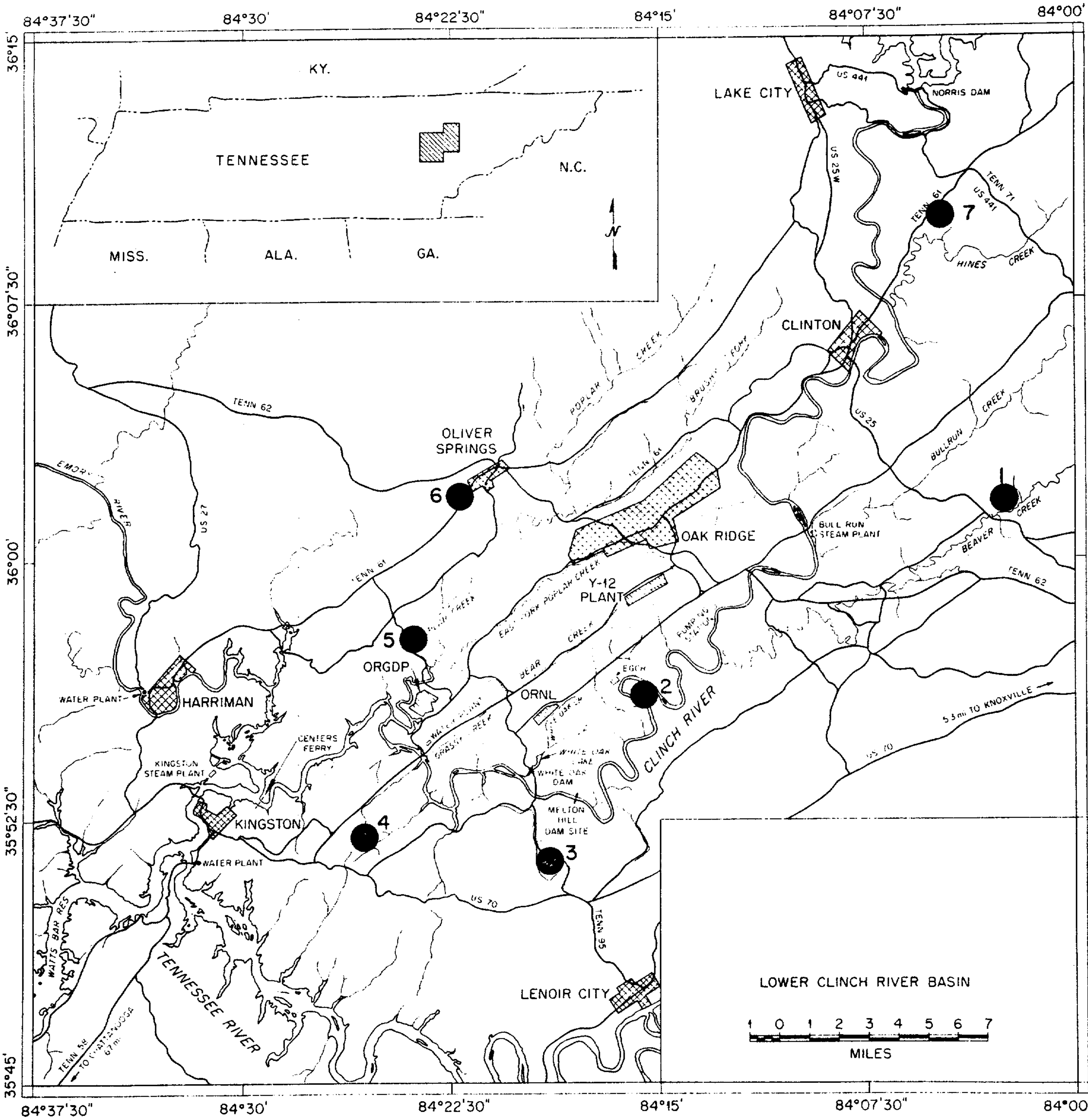

Fig. 4.6 Milk Sampling Stations

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UNION CARBIDE NUCLEAR COMPANY
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64-8-84

DATE: August 27, 1964

COPY NO. 113

SUBJECT: APPLIED HEALTH PHYSICS QUARTERLY REPORT - APRIL, MAY AND JUNE, 1964

TO: K. Z. Morgan - W. S. Snyder

FROM: D. M. Davis

NOTICE

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - APRIL, MAY AND JUNE, 1964

D. M. Davis, Section Chief

Data Contributed By:

H. H. Abee
R. L. Clark
B. R. Fish
E. D. Gupton
A. D. Warden

J. C. Hart, Editor

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1.0 MONITORING SUMMARY

1.1 Unusual Occurrences

There were five unusual occurrences this quarter. (The average number per quarter in 1962 and 1963 was 14 and 11, respectively.)

1.2 Personnel Exposures

One exposure exceeded 1/3 of the maximum permissible dose for this quarter. (The highest exposure was 1.3 rem, or 43% of quarterly maximum permissible.)

1.3 Air Contamination

Average concentration of radioactivity at 10 LAM stations located on or near the X-10 site was 2.5×10^{-12} μc/cc or < 1% $(MPC)_a$ for occupational exposure. (Average for 1963: 4.9×10^{-12} μc/cc.)

1.4 Water Contamination

Calculated average concentration of radioactivity in the Clinch River at the mouth of White Oak Creek (assuming uniform dilution): 3% of $(MPC)_w$ for the neighborhood. (Average for 1963: 4.7%.)

1.5 Background Radiation

Average for 53 stations located on or near X-10 site: 0.08 mR/hr. (Averages for 1963 and 1943 were 0.10 mR/hr and 0.012 mR/hr, respectively.)

1.6 Milk Analysis (^{131}I)

Average concentration for station nearest to ORNL: < 10 pc/l, or < 10% of the maximum for FRC Range II. (Average for this station in 1963: 18 pc/l.)

2.0 RADIATION SURVEY SECTION

2.1 Summary of Unusual Occurrences

Five unusual occurrences were recorded during the second quarter. One of the occurrences was classified as a radiation event; the remaining four were classified as minor occurrences.[1] Two of the occurrences were attributed to faulty or inadequate equipment (Table 2.1, Items 2 and 4); the other three occurrences were attributed to failure to use adequate care in some part of an operation (Table 2.1, Items 1, 3, and 5).

Contamination of the work area and/or equipment as well as personnel was involved in all five occurrences noted above. Three operating facilities were involved: one operating facility experienced three occurrences; two facilities experienced one unusual occurrence each. Four of the occurrences took place in facilities engaged primarily in chemical operations; one occurrence involved a laboratory physics experiment.

2.2 Radiation Events

The one radiation event that was recorded involved area, equipment, and personnel contamination. It occurred during the transfer of ^{240}Pu foils from a shipping container to a laboratory hood (Table 2.1, Item 2). Decontamination of the hood and other facilities was performed at a cost of approximately $1,000. The cost of clean-up (excess of $500) required that the occurrence be classified as a radiation event.

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[1]The method for classifying unusual occurrences is given in ORNL-3665, pp 14-15.

Table 2.1 Radiation Occurrences Tabulated for 2nd Quarter, 1964

No.	Date	Facility(s) Involved	Division(s) Involved	Subject of Unusual Occurrence Reported
1.	4/9/64	Bldg. 3517	Isotopes	Personnel and surface contamination resulting from the handling of equipment removed from a contaminated cell.
2.	4/23/64	Bldg. 5500 (Rm-206)	Physics	*Personnel and surface contamination resulting from transfer of ^{240}Pu foils from shipping container to a laboratory hood.
3.	4/27/64	Bldg. 3517 (Cell # 27)	Isotopes	Personnel and surface contamination resulting from opening an isotope shipping container.
4.	5/28/64	Bldg. 3517 (N. Pad Area)	Isotopes	Personnel and area contamination resulting from a contaminated HRT carrier.
5.	6/26/64	Bldg. 3019 (Sample Gallery)	Chem. Tech.	Personnel and surface contamination resulting from the collection of product samples in a sampling gallery.

*Classified as radiation event.

3.0 DOSIMETRY SECTION

3.1 Personnel Monitoring

3.1.1 External Dosimetry - No individual exceeded a recommended maximum quarterly dose during the second quarter of 1964. The highest exposure, in terms of the percentage of a recommended maximum dose level, was a whole body dose of 1.3 rem which represents 43 per cent of the recommended maximum quarterly dose of 3 rem. Only two individuals received a whole body dose that equalled or exceeded 1/3 of the recommended maximum quarterly dose. The highest whole body skin dose received during the quarter was 3.3 rem, which is about 33 per cent of the recommended maximum quarterly limit. A tabulation of the ten highest personnel exposures is shown in Table 3.1.

3.1.2 Internal Dosimetry

Bio-Assays - No employee received an internal exposure during the second quarter which resulted in a body burden of more than 50 per cent of the maximum permissible body burden. Urine sampling of an employee exposed to ^{3}H during the fourth quarter of 1963 continues to show the predicted decrease in body burden (see AHP Quarterly Report, ORNL CF-64-3-3). Analyses of body fluids specimens submitted by three employees exposed to ^{90}Sr earlier this year indicate that continued surveillance will be required for the next few months (see AHP Quarterly Report, ORNL CF-64-6-49). Three employees, all of whom have been under observation for several months, continue to show estimated bone burdens of ^{239}Pu which approximate 1/3 of the maximum permissible body burden.[1]

Whole Body Counter[2] - A total of 414 human counts on 381 persons was carried out by the staff of the Whole Body Counting Facility during the second quarter. Only two individuals indicated amounts of radioactivity above one per cent of the maximum permissible body burden. Table 3.2 gives the highest values of analyses performed by whole body counting techniques during the quarter.

3.2 Program Developments

3.2.1 ORNL Whole Body Counter Program - An Electro-Data Processing (EDP) program for tabulation on In Vivo Gamma Spectrometer preliminary data was completed and tested during the second quarter. The program, to be put into operation at the beginning of the third quarter, will make it possible to inform the Divisions, routinely, of IVGS preliminary results.

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[1]Action is taken to curtail an employee's exposure to internal emitters of long half-life when the estimated body burden approaches 30 per cent of a recommended maximum body burden.

[2]Data supplied by Health Physics Technology Section, B. R. Fish, Section Chief.

3.2.2 Quarterly Bio-Assay Summary - An EDP program for summarizing and reporting bio-assay data on a quarterly basis was completed, tested, and put into operation during the second quarter.

3.2.3 HP Portable Instrument Program - An improved modification of the EDP program which provides inventory and service data information on portable radiation monitoring instruments was outlined during this quarter. The modified program is scheduled to be operational during the third quarter.

3.2.4 Badge-Meters for Construction Personnel - During this quarter, employees of construction contractors who work on projects in the ORNL area were assigned modified ORNL badge-meters. Individuals who are assigned these modified badge-meters are not authorized to enter the radiation control zones. Consequently, no routine monitoring records are kept of these monitoring films; however, the films are processed and visually scanned so that if a significant reading is observed, appropriate action may be taken.

3.2.5 Alpha Scintillation Counter - A prototype, "large area" (15 cm x 30 cm) alpha scintillation counter has been fabricated, tested, and evaluated, and found to be adequate for health physics-type surface contamination monitoring.

Table 3.1 Personnel Meters Exposure Summary—2nd Quarter, 1964

Code Designation	Laboratory Division	Second Quarter Dose		Cumulative Dose thru 2nd Qtr.	
		Skin of Whole Body (rem)	Whole Body (rem)	Skin of Whole Body (rem)	Whole Body (rem)
1	Isotopes	3.3	<u>1.3</u>	6.3	2.0
2	Isotopes	1.3	1.0	2.3	2.0
3	Isotopes	1.5	0.9	2.9	2.1
4	Isotopes	2.2	0.9	5.0	1.8
5	Isotopes	1.9	0.8	3.1	1.7
6	Isotopes	1.0	0.8	2.5	2.0
7	Isotopes	1.0	0.8	2.1	1.7
8	Health Physics	1.4	0.8	1.8	1.1
9	Isotopes	1.0	0.8	2.1	1.4
10	Isotopes	1.5	0.8	2.3	1.3

NOTE: The ten persons (listed above by code number) are those individuals monitored at ORNL whose metered dose represented the highest percentage of a recommended maximum dose; the underlined value exceeds approximately 1/3 of the recommended quarterly dose. The term "dose" means "dose equivalent".

Table 3.2 Isotopes Found by Whole Body Counting (Total Body Burden) and Maximum Amounts Detected

Isotope	Detectable Amount of Radionuclide	Maximum Amount Detected (μc)	Approximate Per Cent MPBB
^{58}Co	14	.010	< .05
^{60}Co	7	.013	.13
^{75}Se	1	.006	< .05
^{90}Sr	20	(.52)*	(68)*
^{95}Zr - ^{95}Nb	20	.044	.22
^{106}Ru - ^{106}Rh	17	.020	.67
^{125}Sb	14	.018	< .05
^{131}I	4	.009	1.3
^{144}Ce - ^{144}Pr	2	Trace	--
^{235}U	1	Trace	--

*Chest count

4.0 ENVIRONMENTAL MONITORING

4.1 Atmospheric Monitoring

The concentration of radioactivity in the air sampled by network stations located at the X-10 site and over the East Tennessee area increased slightly (Fig. 4.1) during the second quarter of 1964. The average weekly concentration of radioactive materials in air sampled by the three ORNL air monitoring networks are shown in Table 4.1. The quarterly average for the LAM[1] network was 2.5 x 10^{-12} μc/cc with weekly values at individual monitoring stations ranging from a minimum of 0.1 x 10^{-12} μc/cc to a maximum of 6.2 x 10^{-12} μc/cc. Averages for the PAM[2] and RAM[3] networks were 1.6 x 10^{-12} μc/cc and 2.0 x 10^{-12} μc/cc respectively with weekly values ranging from a minimum of 0.42 x 10^{-12} μc/cc to a maximum of 4.8 x 10^{-12} μc/cc. The slight increases in air activity levels during the second quarter are attributed to seasonal phenomena normally observed in the northern hemisphere during the spring months when fall-out from weapons testing tends to increase.[4]

Atmospheric radioiodine, as measured by the PAM network, averaged about 0.02 x 10^{-12} μc/cc, or about 0.007 per cent of the $(MPC)_a$ for ^{131}I, during the second quarter of 1964. The highest average concentration measured by the PAM network during any one week was 0.09 x 10^{-12} μc/cc with the concentrations observed at individual stations during this particular week ranging from a low of < 0.008 x 10^{-12} μc/cc to a high of 0.18 x 10^{-12} μc/cc. During the week of highest concentration 6.8 curies of radioiodine were released from the 3039 off-gas stack.[5] The total quantity of radioiodine discharged to the environment from Laboratory stacks during the second quarter was approximately 15 curies.[6]

4.2 Fall-Out Measurements

Fall-out measurements, as determined by the LAM, PAM and RAM networks from gummed paper techniques,[7] indicated that the relatively low fall-out levels measured during the first quarter of 1964 continued through the second quarter of 1964 (Fig. 4.2). Weekly average particulate fall-out data for the three monitoring networks are presented in Table 4.2.

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[1] LAM - Local Air Monitor (located at or near the X-10 site).

[2] PAM - Perimeter Air Monitor (located on the outer boundary of the AEC-Controlled area).

[3] RAM - Remote Air Monitor (located from 12 to 75 miles from the X-10 site).

[4] "Radioactive Fall-Out From Nuclear Weapons Tests", TID 7632, Book 1 (1962), pp 159-165.

[5] "Summary of Waste Discharges, Week Ending 4-12-64", L. C. Lasher.

[6] Monthly Reports - "Laboratory Facilities - Waste Disposal", L. C. Lasher.

[7] The gummed paper collector presents a collection surface of 1 square foot. Radioparticulates per square foot are determined by autoradiography.

4.3 Water Analyses

Rain Water - The quarterly average concentration of radioactive materials deposited in rain-water collected within the LAM network was 0.30×10^{-6} $\mu c/ml$. The averages for the years 1959 through 1963 and the quarterly averages for the first two quarters of 1964 are shown in Fig. 4.3. The PAM and RAM network averages were 0.30×10^{-6} $\mu c/ml$ and 0.28×10^{-6} $\mu c/ml$ respectively (Table 4.3).

Clinch River Water - Approximately 57 curies of radioactive materials were discharged via White Oak Creek into the Clinch River during the second quarter of 1964. About 72 per cent of the radioactive materials in White Oak Lake effluent was attributed to ^{106}Ru which enters White Oak Creek mainly from the seepage pit disposal system.[6] However, ^{106}Ru contributed only about 13 per cent to the calculated maximum permissible concentration for drinking water, $(MPC)_w$, derived from the mixture of radionuclides known to be carried by White Oak Lake effluent as it passes into Clinch River water at Clinch River Mile (CRM) 20.8. The isotopic distribution of the White Oak Lake effluent is given for the months of April, May and June in Table 4.4. Assuming uniform mixing of White Oak Lake effluent with Clinch River water at the confluence of the two streams (CRM 20.8) the calculated monthly gross beta concentrations in the Clinch River resulting from ORNL liquid waste discharges were as follows:

Month	Concentration[8]	% $(MPC)_w$[9]
April	0.34×10^{-6} $\mu c/ml$	5.5
May	0.13×10^{-6} $\mu c/ml$	2.6
June	0.04×10^{-6} $\mu c/ml$	0.8
	Average	3.0

The average concentrations of the major radioactive constituents in Clinch River water at CRM 20.8 resulting from Laboratory waste releases are given in Table 4.5.

The measured average concentrations of radioactive materials in Clinch River water sampled at the ORGDP filtration plant intake (CRM 14.5) were as follows:

Month	Concentration	% $(MPC)_w$
April	0.11×10^{-6} $\mu c/ml$	2.8
May	0.14×10^{-6} $\mu c/ml$	3.4
June	0.04×10^{-6} $\mu c/ml$	1.4
	Average	2.5

[8] Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that may be carried by the river upstream from CRM 20.8

[9] Weighted average $(MPC)_w$ for persons residing in the neighborhood of a controlled area calculated for the isotopic mixture using $(MPC)_w$ values for specific radionuclides specified by AEC Manual Chapter 0524, Appendix, Annex I, Table II.

A comparison of the per cent $(MPC)_w$, by months, for the second quarter of 1964 with values determined for the first quarter of 1964 and yearly values for the years 1956 through 1963 is shown in Fig. 4.4.

The concentration of ^{90}Sr and ^{106}Ru in Clinch River water at the ORGDP water filtration plant intake (CRM 14.5) is given in Table 4.6.

4.4 Background Measurement of Ionizing Radiation

The average background level recorded during the second quarter at 53 stations located on or near the X-10 site was 0.08 mR/hr (Table 4.7). The background levels measured at individual stations ranged from a minimum of 0.01 mR/hr to a maximum of 1.6 mR/hr. The average level recorded at the five stations located around the perimeter of the AEC controlled area was 0.01 mR/hr. The average background levels determined for the first and second quarters of 1964 and the years 1959 through 1963 are given in Fig. 4.5. The 1943 off-site average value was 0.01 mR/hr.

4.5 Raw Milk Analysis

One new station was added to the raw milk sampling network during the quarter bringing the total number of stations now being sampled to twelve. Raw milk samples are collected weekly at each of eight milk sampling stations located on the fringe of the Oak Ridge area (Fig. 4.6); four stations, located more remotely with respect to Oak Ridge Operations are sampled at a rate of one station each week. All milk samples are analyzed for ^{131}I.

During the second quarter of 1964, the average radioiodine concentration in milk collected at the station nearest to ORNL was < 10 pc/l (the lower limit of detection). The highest concentration observed in any one milk sample was 127 pc/l. (FRC Range II for ^{131}I is 10 to 100 pc/day.)[10]

4.6 Cattle Thyroid Analysis

A total of 63 cattle thyroids was assayed for radioiodine content during the quarter. The average of all samples analyzed was approximately 5 pc of radioiodine per gram of thyroid tissue. The values ranged from a minimum of 1.0 pc/g, the lower limit of detection, to a maximum of 52 pc/g. The average value, while relatively low, is higher by a factor of approximately 5 than that observed during the last quarter. Higher radioiodine content of cattle thyroids is normally expected during the spring and summer months when cattle are taken off dry feed and turned out to pasture on grass lands.

[10]"Background Material for the Development of Radiation Protection Standards", Staff Report of the Federal Radiation Council, Report No. 2, September 1961.

Table 4.1 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—2nd Quarter, 1964

Week No.	LAM Network[(a)]	PAM Network[(b)]	RAM Network[(c)]
14	2.5×10^{-12} μc/cc	1.8×10^{-12} μc/cc	2.1×10^{-12} μc/cc
15	2.1	1.4	1.8
16	2.8	2.1	2.7
17	1.7	0.9	1.2
18	3.6	2.1	2.9
19	4.5	2.7	3.5
20	2.1	1.4	1.8
21	2.9	1.9	2.3
22	2.5	1.6	2.2
23	2.9	2.0	2.3
24	1.8	1.2	1.6
25	1.4	0.7	1.0
26	1.5	1.1	1.4
Average for Quarter	2.5×10^{-12} μc/cc	1.6×10^{-12} μc/cc	2.0×10^{-12} μc/cc
Average Year to Date	2.1×10^{-12} μc/cc	1.3×10^{-12} μc/cc	1.7×10^{-12} μc/cc
Average Last Year (1963)	4.9×10^{-12} μc/cc	4.0×10^{-12} μc/cc	4.3×10^{-12} μc/cc

[a]LAM - Local Air Monitor located at or near the X-10 site.

[b]PAM - Perimeter Air Monitor located on the outer boundary of the AEC-controlled area.

[c]RAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

Table 4.2 Radioparticulate Fall-Out Measurements Averaged Weekly From Gummed Paper Data—2nd Quarter, 1964

Week No.	LAM Network	PAM Network	RAM Network
14	0.3 particles/ft^2/wk	0.14 particles/ft^2/wk	0.00 particles/ft^2/wk
15	0.5	0.00	0.00
16	1.7	0.29	0.00
17	1.2	0.00	0.00
18	0.5	0.14	0.14
19	0.8	0.71	0.00
20	0.1	0.29	0.00
21	1.4	0.00	0.00
22	0.9	0.00	0.00
23	0.7	0.14	0.00
24	0.3	0.14	0.00
25	0.4	0.00	0.29
26	0.4	0.14	0.00
Average for Quarter	0.7 particles/ft^2/wk	0.15 particles/ft^2/wk	0.03 particles/ft^2/wk
Average year to date	0.9 particles/ft^2/wk	0.16 particles/ft^2/wk	0.08 particles/ft^2/wk
Average last year (1963)	17 particles/ft^2/wk	16 particles/ft^2/wk	10 particles/ft^2/wk

Table 4.3 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—2nd Quarter, 1964

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	0.30×10^{-6} μc/ml
	PAM Network	
HP-31	Kerr Hollow Gate	0.35×10^{-6} μc/ml
HP-32	Midway Gate	0.28
HP-33	Gallaher Gate	0.30
HP-34	White Oak Dam	0.27
HP-35	Blair Gate	0.37
HP-36	Turnpike Gate	0.37
HP-37	Hickory Creek Bend	0.19
Network Average		0.30×10^{-6} μc/ml
	RAM Network	
HP-51	Norris Dam	0.36×10^{-6} μc/ml
HP-52	Loudoun Dam	0.35
HP-53	Douglas Dam	0.23
HP-54	Cherokee Dam	0.42
HP-55	Watts Bar Dam	0.18
HP-56	Great Falls Dam	0.24
HP-57	Dale Hollow Dam	0.20
Network Average		0.28×10^{-6} μc/ml

Table 4.4 Radioisotopic Distribution in White Oak Lake Effluent—2nd Quarter, 1964

Isotope	% of Total Beta Radioactivity		
	April	May	June
^{106}Ru	79.7	73.4	64.5
^{95}Zr	< 0.1	< 0.1	< 0.1
^{95}Nb	< 0.1	< 0.1	< 0.1
^{144}Ce	0.2	0.2	0.2
TRE (less ^{144}Ce)*	4.6	10.4	16.5
^{137}Cs	3.3	2.8	2.5
^{131}I	0.1	0.2	0.9
^{140}Ba	< 0.1	< 0.1	0.2
^{60}Co	7.9	6.7	9.7
^{89}Sr	0.4	0.6	0.5
^{90}Sr	3.5	5.7	4.9

*TRE-Total rare earths

Table 4.5 Calculated Average Concentration of Major Radioactive Constituents in the Clinch River at Mile 20.8 Resulting from ORNL Waste Releases via White Oak Lake - 2nd Quarter, 1964[a]

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)					Gross Beta	$(MPC)_w$[b]	%
	^{90}Sr	^{144}Ce	^{137}Cs	^{106}Ru	^{60}Co	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
April	0.33	0.01	0.30	7.1	0.70	0.34	6.1	5.5
May	0.27	0.01	0.13	3.5	0.32	0.13	5.0	2.6
June	0.17	0.01	0.09	2.2	0.33	0.04	5.0	0.8

[a] Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter upstream from CRM 20.8.

[b] Weighted average $(MPC)_w$ for populations residing in the neighborhood of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

Table 4.6 Average Concentration[a] of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—2nd Quarter, 1964

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)		Gross Beta	$(MPC)_w$[b]	%
	^{90}Sr	^{106}Ru	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
April	0.63	7.6	0.11	4.1	2.8
May	0.72	10.3	0.14	3.9	3.4
June	0.41	2.5	0.04	2.7	1.4

[a]Observed values based on analyses of monthly composited samples.

[b]Weighted average $(MPC)_w$ for populations in the vicinity of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

Table 4.7 Background Measurements of Ionizing Radiation—2nd Quarter, 1964

Area	Monthly Average for All Stations (mR/hr)			Quarterly Average for All Stations (mR/hr)	Year to Date Average All Stations (mR/hr)
	April	May	June		
Laboratory Site (53 Stations)	0.08	0.08	0.09	0.08	0.07
Off-Site (Oak Ridge Controlled Area) (5 Stations)	0.01	0.02	0.01	0.01	0.01

NOTE: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

UNCLASSIFIED
ORNL-DWG 64-1282R3

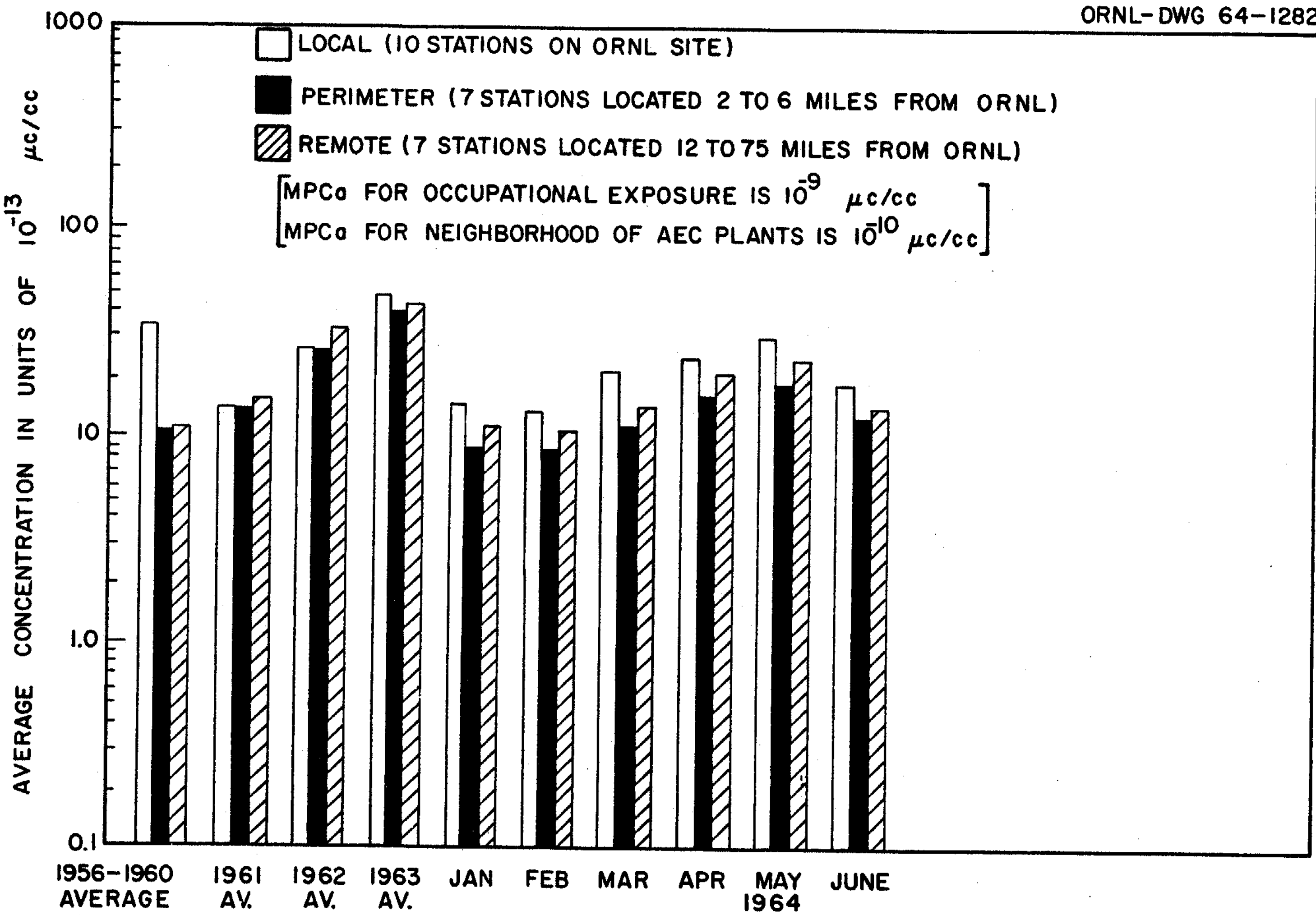

FIG. 4.1 CONCENTRATION OF RADIOACTIVE MATERIALS IN AIR (FILTER PAPER DATA)

UNCLASSIFIED
ORNL-DWG. 64-1284R1

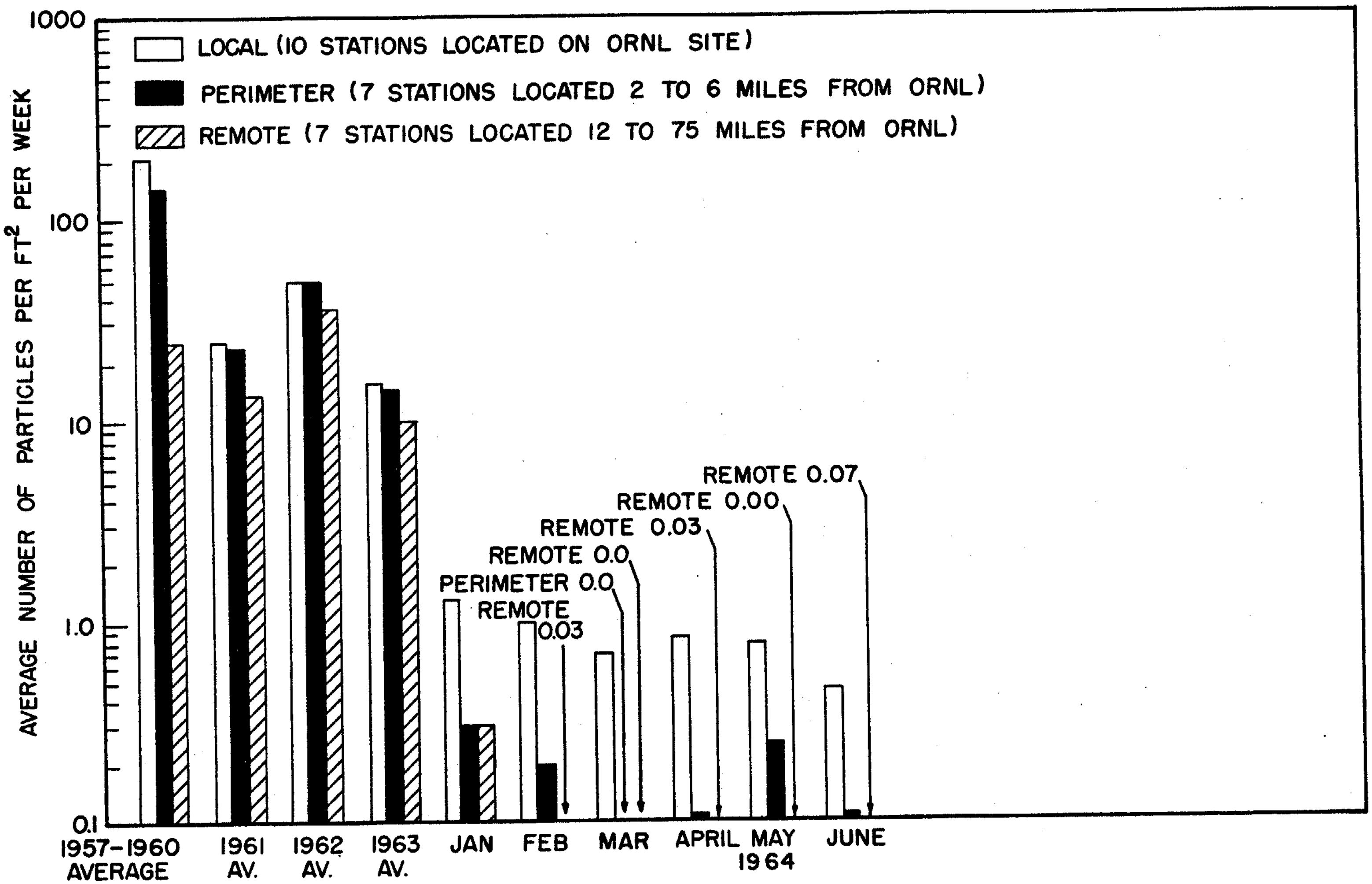

FIG. 4.2 RADIOPARTICULATE FALL-OUT MEASUREMENTS (MEASURED BY AUTORADIOGRAPHIC TECHNIQUES USING GUMMED PAPER COLLECTORS)

UNCLASSIFIED
ORNL – DWG. 64-1283R1

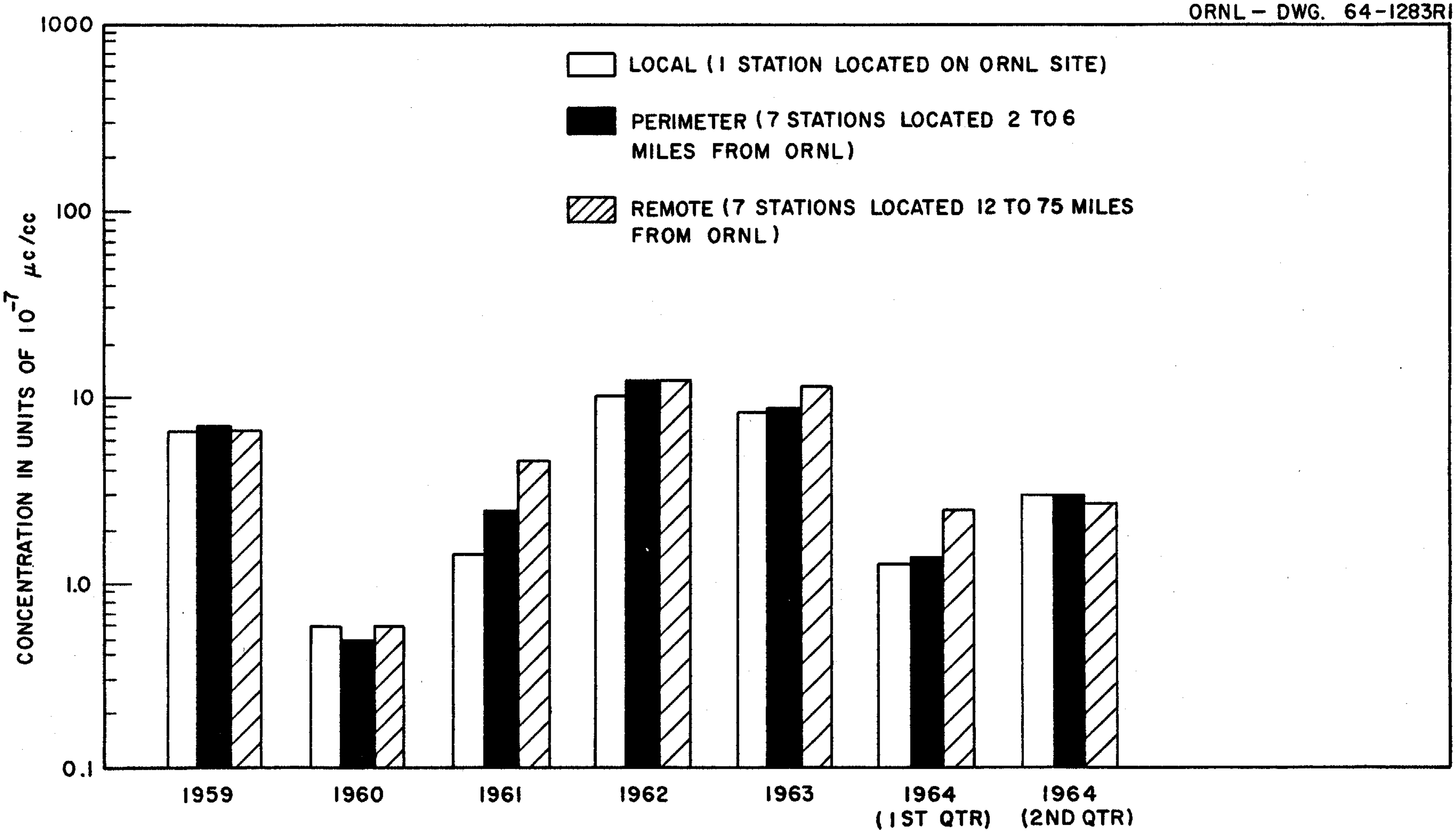

FIG. 4.3 CONCENTRATION OF RADIOACTIVE MATERIALS IN RAIN WATER

UNCLASSIFIED
ORNL-DWG. 64-1285R2

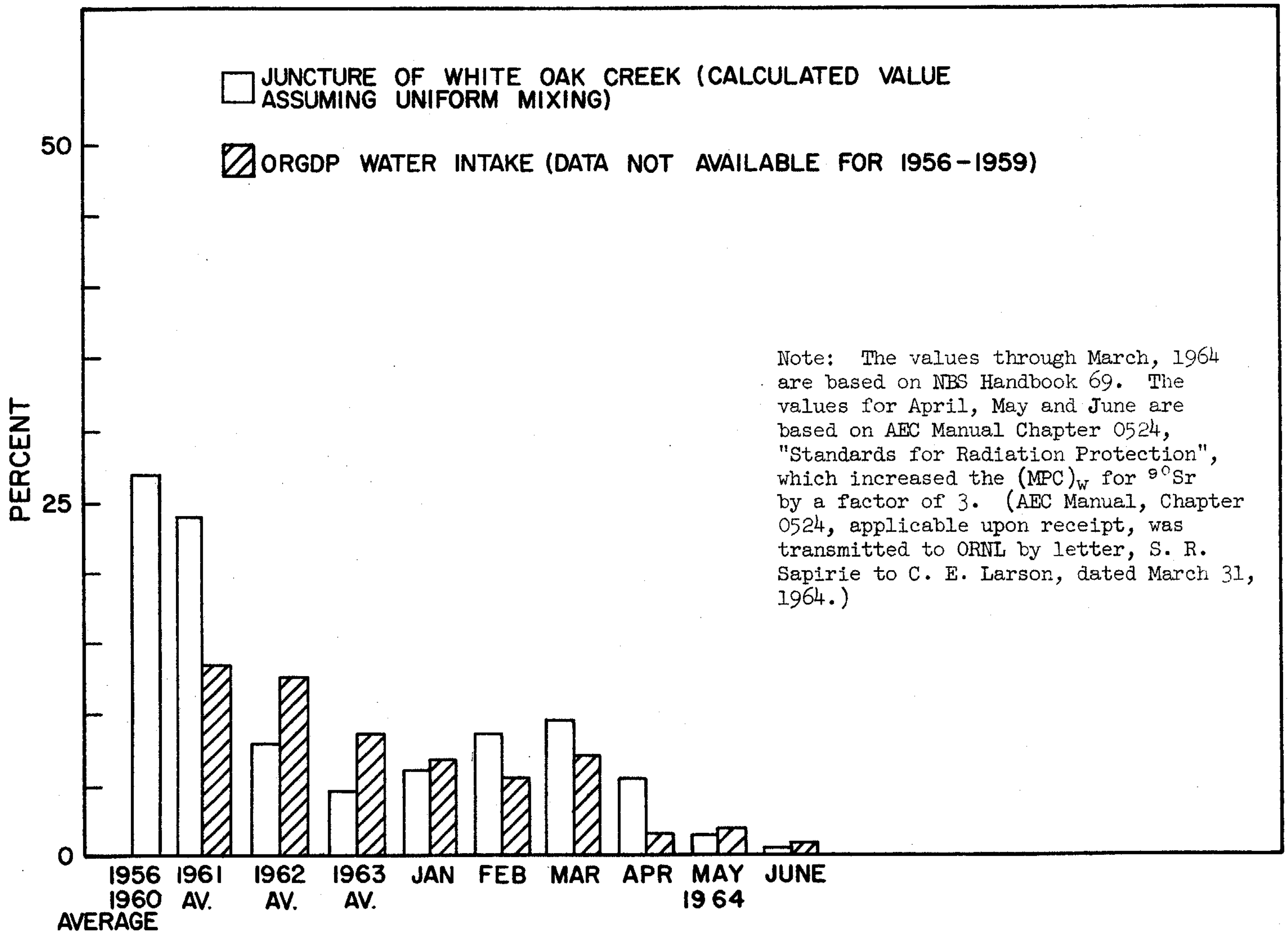

FIG. 4.4 % $(MPC)_w$ OF RADIOACTIVITY IN CLINCH RIVER WATER

UNCLASSIFIED
ORNL-DWG.-64-1281R1

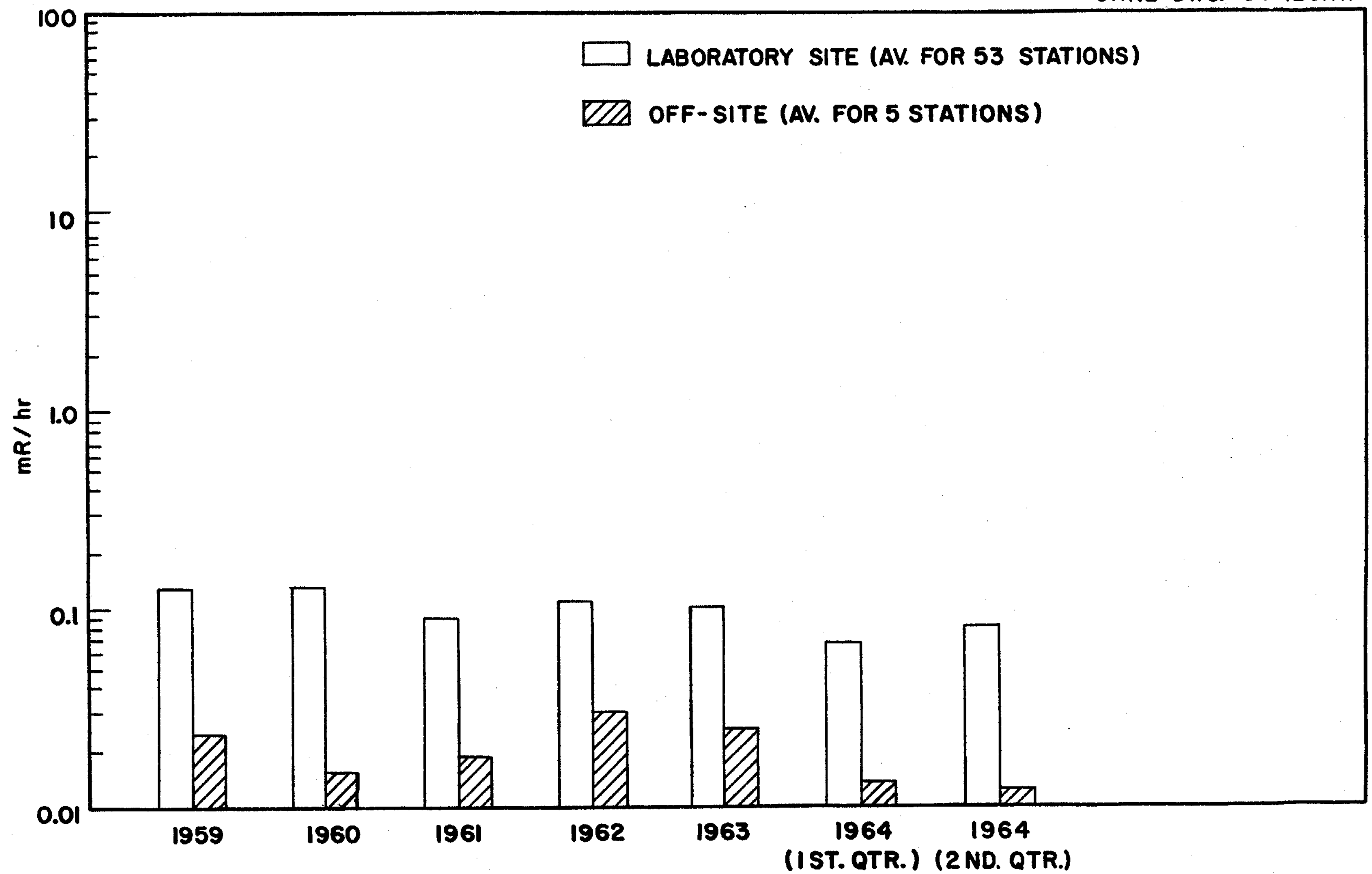

FIG. 4.5 BACKGROUND MEASUREMENTS OF IONIZING RADIATION

UNCLASSIFIED
ORNL—DWG. 64-3713 RI

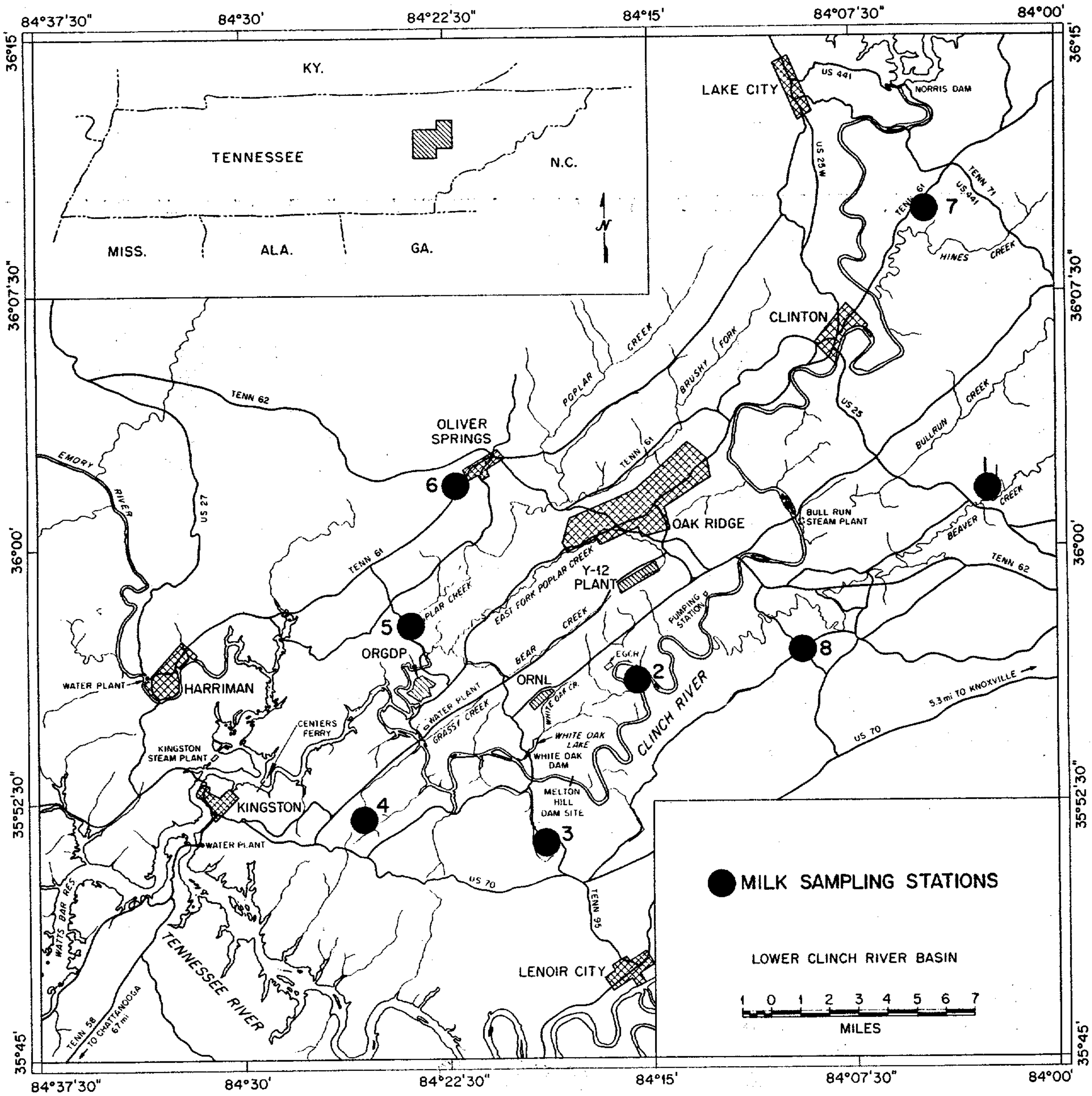

Fig. 4.6. Location of Milk Sampling Stations.

DISTRIBUTION

1. K. Z. Morgan
2. W. S. Snyder
3. J. A. Swartout
4. A. M. Weinberg
5. H. H. Abee
6. R. G. Affel
7. T. A. Arehart
8. E. A. Bagley
9. L. H. Barker
10. S. E. Beall
11. A. F. Becher
12. Carlos G. Bell
13. D. S. Billington
14. E. P. Blizard
15. A. L. Boch
16. N. E. Bolton
17. C. J. Borkowski
18. G. E. Boyd
19. J. W. Boyle
20. R. B. Briggs
21. F. N. Browder
22. F. R. Bruce
23. T. J. Burnett
24. G. C. Cain
25. A. D. Callihan
26. W. R. Casto
27. R. L. Clark
28. A. J. Cook
29. W. B. Cottrell
30. K. E. Cowser
31. J. A. Cox
32. F. L. Culler
33-52. D. M. Davis
53. L. G. Farrar
54. B. R. Fish
55. J. L. Fowler
56. J. H. Frye
57. C. B. Fulmer
58. D. C. Gary
59. J. H. Gillette
60. W. Y. Gissel
61. W. R. Grimes
62. E. D. Gupton
63. C. E. Guthrie
64. R. B. Hammond
65. Craig Harris
66. J. C. Hart
67. Alexander Hollaender
68. A. S. Householder
69. J. T. Howe
70. T. W. Hungerford
71. C. H. Johnson
72. R. W. Johnson
73. W. H. Jordan
74. G. W. Keilholtz
75. C. P. Keim
76. M. T. Kelley
77. C. V. Ketron
78. K. K. Klindt
79. K. A. Kraus
80. J. A. Lane
81. T. A. Lincoln
82. R. S. Livingston
83. H. G. MacPherson
84. A. J. Miller
85. E. C. Miller
86. M. L. Nelson
87. A. R. Olsen
88. F. L. Parker
89. M. E. Ramsey
90. M. L. Randolph
91. L. P. Riordan
92. A. F. Rupp
93. G. S. Sadowski
94. H. M. Sartelle
95. H. E. Seagren
96. C. S. Shoup (AEC-ORO)
97. A. H. Snell
98. W. M. Stanley
99. E. H. Taylor
100. A. D. Warden
101. R. H. Winget
102. E. J. Witkowski
103. Gale Young
104-109. Laboratory Records
110-111. Central Research Library
112. Document Reference Section
113. Laboratory Records - RC